PROJECT MANUAL

UNIVERSITY OF OREGON – ORRGON BACH FESTIVAL

100% DESIGN DEVELOPMENT

May 6, 2016

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UNIVERSITY OF OREGON - OREGON BACH FESTIVAL
University of Oregon
Eugene, OR 97403

May 6, 2016
Project #1528

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GEOTECHNICAL DATA

PART 1 SUMMARY

1.1 SOILS REPORT

A. A copy of the soils investigation report is available for review at the Architect's office. The report is entitled Geotechnical Investigation Oregon Bach Festival Offices dated March 28, 2016, prepared by GRI.

B. This report was obtained for use only in design and is not a part of the Contract Documents.

C. Report and log of test borings are for information only and are not a warranty of subsurface conditions.

1.2 SITE INVESTIGATION BY BIDDER

A. Prior to bidding, bidders may visit the site and make their own subsurface investigation to satisfy themselves with subsurface conditions. Bidders shall take all precautions for protecting existing property, and shall repair to original condition any damage done to structures, plant material, and ground.

1.3 CHANGE ORDER REQUESTS

A. The selected contractor may submit a Request for Change Order if subsurface conditions vary substantially from those found in the Owner's soil investigation.

END OF DOCUMENT

AGREEMENT BETWEEN CONTRACTOR AND ARCHITECT CONCERNING USE OF ELECTRONIC MEDIA

1. Contractor has requested that Architect provide to it, certain plans, specifications, and other documents in electronic media such as CAD and REVIT MODEL form ("FILES") for _____ _____("PROJECT"). Contractor has requested that Architect furnish FILES in order for Contractor, its subcontractors, and other consultants to expedite their work. Contractor acknowledges and agrees that the FILES are not intended to be used for construction; may not include all known or contemplated revisions at the time of transfer; are not Contract Documents under the terms of the Construction Contract; may be inaccurate as a result of electronic storage, transmission, technology compatibility or related issues; and may be revised by others without the knowledge or consent of the Architect or, when plotted, may result in variances or corrupt files of the Contractor.

2. Architect is nevertheless willing to provide the FILES on the terms and conditions specified herein.

3. Contractor agrees neither this Agreement nor the transfer of the FILES in any way restricts Architect's use of the FILES. Contractor agrees not to use the FILES for any purpose prohibited herein or project other than the Project for which it was prepared. The Contractor agrees to cease all use of the FILES by it and its subcontractors and consultants and return or destroy all such FILES in its possession or control upon written direction of Architect.

4. Contractor acknowledges that the FILES are the property of the Architect and subject to the copyright of the Architect. The electronic media disks may be write-protected by Architect such that no data on such disk can be manipulated. Architect will provide to the Contractor only a working copy electronic media disk. Said working copy disk shall have all indices of the Architect's Ownership, professional name, and/or involvement in the PROJECT removed from the electronic display. Any use of any kind and/or changes to the FILES, including by Contractor, its subcontractors, and consultants, will be at the Contractor's sole risk, and without liability, risk or legal expense to the Architect. The Contractor and any other person or entity using the FILES agrees to release and, to the fullest extent permitted by law, defend, indemnify, and hold harmless the Architect and its consultants and their partners, shareholders, agents and employees from and against any and all claims, demands, losses, expenses, damages, penalties and liabilities of any kind including without limitation, attorneys' fees arising out of or relating in any way to any such use of or change to the FILES or breach of this Agreement.

5. Under no circumstance shall the transfer of the FILES for use of the Contractor be deemed a sale by the Architect, and the Architect makes no warranties, either expressed or implied, of merchantability and fitness for any particular purpose.

6. Contractor agrees, as a condition of forwarding the FILES to its subcontractors or any other consultant, person or entity, to obtain the prior written approval of Architect for each recipient and to require such third party to agree in writing to the terms and conditions of this Architect's Agreement Concerning Use of Electronic Media and provide evidence of such agreement to the Architect before forwarding the FILES.

7. Nothing with respect to this Agreement or the transfer of the FILES is intended to or does create a right of Contractor or its subcontractors or consultants to rely upon the FILES or implies review or approval of the FILES by the Architect. Contractor, its subcontractors and consultants are not third party beneficiaries of Architect's agreement with the Project Owner.

Read and accepted by:

ARCHITECT:	CONTRACTOR:
_____	_____
Signature	Signature
_____	_____
Print Name	Print Name
Dated: _____	Dated: _____

TEMPORARY TREE AND PLANT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Protection of existing trees from damage.

1.2 RELATED SECTIONS

A. Section 328000 Irrigation.

B. Section 329000 Planting.

1.3 REFERENCE STANDARDS

A. ANSI A300 - Tree Care Operations Standards

1.4 DEFINITIONS

A. Designated Trees: Existing Trees to Remain as indicated on Drawings.

B. Critical Root Zone (CRZ): The CRZ for trees 4 inches in caliper or smaller shall be an area with a radius at least 5 feet from the trunk. The CRZ for trees over 4 inches in caliper shall be an area with a radius of at least 1 foot 6 inches from the trunk for every 1 inch of caliper size.

C. Zone of Protection: CRZ and as indicated on Drawings.

1.5 POSTING

A. When directed, post Designated Trees with Notice sign provided by Owner's Representative. Attach sign to tree with twine or staples, no nails. Maintain and protect the Notice sign until completion of construction. Obtain approval of Owner's Representative prior to removal of sign.

1.6 NOTICE

A. Notify all workers, including subcontractors, of the requirements to protect Designated Trees using Notice provided.

1.7 PROTECTIVE FENCING

A. Install protective fencing around Designated Trees, where shown on Drawings, prior to commencement of any work. Fencing to be a minimum 6 foot chain link, with fence posts securely anchored. Maintain during construction. Adjustments to fence locations are to be approved by the Owner's Representative prior to performing any work within the Zone of Protection.

1.8 TRENCHING AND EXCAVATION

A. All trenching and excavation within the Zone of Protection is to be performed with the use of an air spade, vac-ex, or by hand. Obtain Owner’s Representative approval of trenching and excavation locations and methods prior to performing any work.

1.9 ROOT PRUNING

A. Prune roots encountered during construction with an approved root-pruning device. Make clean, vertical cuts. Do not leave split or frayed ends. Obtain Owner's Representative approval prior to cutting roots larger than 1 1/2 inches in diameter. Backfill exposed roots with specified Planting Soil as soon as practical.

1.10 TREE CANOPY PRUNING

A. Prune canopies of Designated Trees impacted by construction only upon approval of Owner's Representative. All canopy pruning must be performed by a certified arborist.

1.11 MULCH

A. Provide four (4) inch deep mulch within zone of protection as directed.

1.12 WATERING

A. Water trees if required by Owner's Representative. Watering will be required if it is judged that root removal is necessary for construction and threatens the survival of the tree. Use a slow drip or soaker hose to provide one-inch water per week until completion of construction.

1.13 PROHIBITED ACTIVITIES

A. Cutting of roots larger than 1 1/2 inch diameter or larger without approval.

B. Damaging tree bark, branches.

C. Removal of protective fencing or notice posted on trees prior to approval of Owner's Representative.

D. Activities prohibited within the Zone of Protection (without prior approval) are, but not limited to: construction, operation of machinery, storage of materials, paving, grading, cutting, filling, travel within, dumping, disposal of liquids, and parking of vehicles or equipment.

1.14 DAMAGE

A. Actual tree damage such as trunk scoring and broken limbs or damaged roots inside the Zone of Protection will be assessed according to the percentage of loss of tree value. Percentage of tree value will be determined by the Owner's Representative. Tree value will be determined from "Evaluation of Landscape Trees, Shrubs, and Other Landscape Plants" by International Society of Arboriculture.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

AMBIENT NOISE PERFORMANCE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. This section specifies ambient noise levels allowable when spaces are unoccupied while mechanical, electrical, conveying and other equipment is operating. Refer to Contract Documents for vibration isolation and noise control systems and requirements.

1.2 REQUIREMENTS

A. Provide equipment and materials and install systems in a manner that conforms to the requirements of the Contract Documents. As required to meet scheduled ambient noise levels, Contractor shall replace unapproved product substitutions and defective or improperly installed materials before the end of the warranty period.

1.3 DEFINITIONS

A. This section and other specifications will use the term *acoustically sensitive* for rooms with criteria between RC-25 and RC-34 and the term *acoustically critical* for rooms with criteria below RC-25. For rooms or spaces that are specified as having a range of criteria, the lowest number of the range will dictate whether a room is critical or sensitive.

1.4 LIGHTING SYSTEMS

A. Luminaire components including lamp, housing, ballasts, and wiring shall operate silently and inaudibly at all points of operation between and including 0-100% power in acoustically sensitive/critical spaces.

1.5 FIRE ALARM SYSTEMS

A. System components including initialization devices, annunciators, visual and audible devices, shall operate silently and inaudibly in acoustically sensitive/critical spaces except during system emergency and system activation. Components shall not transmit noise between spaces served.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CRITERIA

A. This building has been designed to meet specified ambient noise levels for the following room types:

LIST OF SPACES:	ROOM CRITERIA: RC(N):
Rehearsal Room	RC 20-24(N)

Board Room	RC 20-24(N)
Artistic Director	RC 25-29(N)
Conference	RC 30-34(N)
Library	RC 30-34(N)
Office	RC 30-34(N)
Open Office	RC 35-39(N)
Lobby	RC 35-39(N)
Hallway	RC 35-39(N)

3.2 STANDARDS

A. The maximum Room Criteria (RC) levels acceptable in the octave bands 16 Hz to 4000 Hz shall be as specified in the 2003 ASHRAE Handbook, HVAC Applications, Chapter 47. In addition, the maximum RC-15 and RC-20 noise levels acceptable in the octave bands 16 Hz to 4000 Hz shall be as follows:

	Octave Band Center Frequency (Hertz)								
Criteria	**16**	**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**
RC - 20	55	55	45	38	31	25	20	15	10
RC - 15	55	55	43	35	28	21	15	10	5

3.3 TESTS

A. Following substantial completion, the project Acoustics Consultant will observe and measure noise levels. The measurements will be taken at normal locations of people and/or audio microphones.

END OF SECTION

DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Furnish labor, material and equipment required for the demolition and removal of existing curbs, pavement, vegetation, and other material as required preparatory to site excavation, construction and grading. Include erosion control.

B. Related Sections:

1. Division 1 Section “Temporary Tree Protection.”

2. Division 1 Section “Construction Waste Management and Disposal.”

1.2 CONDITIONS

A. Existing Conditions: Verify existing conditions at the site and include all work evident by site inspection whether or not shown on the Drawings.

C. Field Measurements: The layout on the Drawings has been developed from the survey information available to the Architect. Some variation and adjustment may be required on the site layout. Stake the areas to be cleared and obtain the approval of the Architect prior to starting the clearing operation.

D. Notify the Architect in advance of cutting, alteration or excavation which may affect the structural safety of any portion of the project.

E. All material and debris resulting from demolition Work, unless specifically designated for reuse or to be turned over to the Owner, shall become property of the Contractor and be removed from the site at Contractor’s expense.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect the work to determine amount of existing materials and debris to be removed. Sprinkle and dampen debris and rubbish with water to prevent dust. Remove debris from the site as demolition progresses and do not allow to accumulate on the premises.

3.2 PREPARATION AND COORDINATION

A. Utilities: Coordinate demolition work with affected utility agencies.

B. Laws and Ordinances: Comply with the applicable laws and ordinances governing the disposal of debris on or off the site, and commit no trespass on any public or private property in any operation due to or connected with demolition and site clearing.

3.3 EROSION CONTROL

A. Contractor's erosion control responsibilities include but are not limited to:

1. Conduct all erosion control activities in accordance with all governing jurisdictions including but not limited to city, county, state and federal DEQ requirements.

2. Design erosion control methods.

3. Submit to the governing jurisdictions erosion control documents that have been stamped and signed by a civil engineer licensed in the State of Oregon.

4. Obtain erosion control permits and pay permit fees.

5. Maintain compliant erosion control during construction.

6. Pay all fines and other penalties levied against the Project for non-compliance of erosion control.

3.4 CLEARING AND GRUBBING

A. Clear the site within the limits shown and remove all remaining vegitation and waste material that would interfere with construction operation, except as specifically indicated otherwise on the Drawings.

B. Remove all roots larger than 1-1/4-inch diameter down to 18 inches below grade in building or paved areas and to 8 inches below finished grades over remaining site areas.

C. Apply an approved herbicide to remaining roots under 1-1/4-inch diameter. Cleared items shall be removed from the site or otherwise disposed of by the Contractor.

3.5 DEMOLITION PREPARATION

A. Arrange to shut off indicated utilities with utility companies.

B. Cut off pipe or conduit a minimum of 24-inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.6 DEMOLITION PROTECTION

A. Existing Facilities: Protect adjacent walks, building entries, and other building facilities during demolition operations.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by Architect, items may be removed to a suitable, protected

storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete.

C. Items to be Salvaged: Transport salvaged items to location as designated By Owner. Items that are to be salvaged to the Owner, include, but are not limited to:

1. Light poles.

2. Bike parking structure.

D. Existing Utilities: Maintain utility services indicated to remain and protect them against damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

E. Temporary Protection: Erect temporary protection, such as walks, fences, and railings where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 1 Section "Temporary Facilities and Controls.

1. Protect existing site improvements, appurtenances, and landscaping to remain.

2. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

3. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

4. Provide protection to ensure safe passage of people around demolition area for access to occupied portions of adjacent buildings and structures.

3.7 DEMOLITION, GENERAL

A. General: Demolish indicated site improvements as detailed. Use methods required to complete the Work within limitations of governing regulations and as follows:

B. Site Access and Temporary Controls: Conduct demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. Comply with requirements of Division 1 Section "Construction Waste Management and Disposal."

B. Remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

C. Burning: Do not burn demolished materials.

3.9 REPAIR AND REPLACEMENT

A. Repair or replace all sidewalks, streets, and curbs damaged by the Work of the Project as required by the governing jurisdiction.

END OF SECTION

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the construction of formwork for cast-in-place concrete, coordinating setting of inserts, hangers, sleeves, vapor barrier, and other work to be installed before forms are closed; and removal of forms.

B. Related Sections:

1. Division 3 Sections “Reinforcing Steel,” and “Cast-In-Place Concrete.”

2. Division 7 Section “Bentonite Waterproofing” for coordination of waterstop manufacturers.

1.2 REFERENCES

A. American Concrete Institute (ACI).

B. APA - The Engineered Wood Association.

1.2 SUBMITTALS

A. Submit the following in accordance with Division 1 Section “Submittal Procedures.”

B. Detail Drawings: The contractor shall submit detail drawings conforming to ACI SP-66 and ACI 318/318M and ACI 318/318R. Detail drawings shall show location of cast-in-place elements in the work including form board layout, reveals, cold joints, and form ties in wall elevations in sufficient detail to cover fabrication, placement, stripping, and finishing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed below.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Plywood Form Faces:

1. Structural Concrete: Coated and sealed APA B-B Plyform Class 1, Ext. PS 1-83. Maintain panels clean, recoated, and in like new condition for each reuse.

B. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.

2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates for walls indicated to receive dampproofing or waterproofing.

C. Inserts and Embedded Items: Pressure-preservative treated "Std. & Btr." fir for wood nailers and rough bucks. Schedule 40 PVC or ABS plastic pipe sleeves or poly-foam blocks wherever pipes or conduits pass through concrete work.

D. Form Coatings:

1. Mineral spirit base form release agent. Verify compatibility with subsequent applied finishes and moisture protective coating systems as specified. Use no form oil.

2. Manufacturers:

a. Cresset Chemical "Crete-Lease 880-VOC."

b. Dayton Superior "Clean Strip J100 VOC."

c. Masons Supply Company “Mascokote VOC.”

E. Chamfer Strip:

1. 1/2-inch smooth, 45° angled corner chamfer, 621.

2. Manufacturer: Greenstreak.

F. Waterstop Materials:

1. Multiple composite waterstop cube of laminated, expandable materials reinforced with two layers of polyester netting and non-woven polypropylene.

2. Products: Coordinate manufacturer and product with Division 7 Section “Bentonite Waterproofing.”

a. Cetco “Volclay Waterstop – RX 101.”

b. Tremco Sealants and Waterproofing "Superstop."

G. Vapor Barrier Sheet: ASTM E1745 Class A, and permeance no greater than 0.020 U.S. Perms per ASTM F1249 or ASTM E96. Vapor barrier sheet shall maintain permeance no greater than 0.020 U.S. Perms after conditioning tests per ASTM E154 Sections 8, 11 12 and 13.

1. Stego Industries 15 mil "Stego Wrap Vapor Barrier" and "Stego Wrap Red Polyethylene Tape," 877/223-4333.

2. Fortifiber Building Systems Group "Moistop Ultra 15" and "Moistop Tape," 800/773-4777.

3. W. R. Meadows "Perminator 15 Mil Underslab Vapor-Mat," and High Density Polyethylene Tape, 800-342-5976.

4. Griffolyn "VAPORguard" 15 mil vapor barrier, "Griffolyn Fab Tape" field seam tape, and Griffolyn Ultra VR Tape" repair tape.

PART 3 EXECUTION

3.1 CONSTRUCTION OF FORMWORK

A. Construct forms according to the recommended practices as outlined in ACI "Form Work for Concrete," Special Publication No. 4, and ACI 347. Be prepared to submit loading data, if requested, on any system chosen for use. Design, strength, and safety are the responsibility of the Contractor. Manufacturer’s instructions of pre-engineered forming systems shall take precedence over conflicting requirements of this specification.

B. Construct forms to maintain slopes, lines, and dimensions shown and be straight, plumb, and sufficiently tight to prevent leakage.

C. Securely brace and shore forms to prevent displacement, carry construction loads and safely support the concrete without distortion until set. Limit deflection of faces between studs and of studs and walers to 0.0025 times span. Other tolerances as specified in Schedule 203.1 of ACI 347. Use metal forms wherever forms will remain permanently in place as part of the work.

D. Use metal form ties manufactured for this purpose throughout. Wood separators and twisted wire tying will not be permitted.

E. Coordinate with other trades and provide ample opportunity for sleeves, inserts, hangers and other work to be installed before forms are closed. Do not install any inserts which will impair the strength of construction. Maximum diameter is 1/3 thickness of member in which embedded; minimum spacing is 3 diameters on center. Place anchor bolts for ledgers, plates, and other structural framing as detailed and specified in other Sections. Place inserts accurately, tied and supported securely in place.

F. Provide access openings for cleaning and inspecting forms and reinforcing prior to depositing concrete. Thoroughly inspect forms prior to placing concrete, with all debris completely removed.

G. Bentonite Waterstops: Provide waterstops in construction joints at elevator pits, in all concrete cold joints below grade and all joints above grade exposed to weather, and as detailed. Install waterstops to form continuous seal in each joint using waterstop product designed for each condition. Protect exposed waterstops during progress of work.

H. Vapor Barrier: Verify that compacted underslab base fill is in place, then cover with vapor barrier sheet, lapping edges 6-inches minimum and taping all seams with vapor barrier tape. Use vapor barrier sheet to boot around all penetrations and seal with tape to create a continuous vapor barrier. Do not penetrate vapor barrier with screed pins, wood stakes or other items. Sand or other granular fill prohibited above vapor barrier.

I. Wet down or treat forms before pouring. Remove forms only when concrete is sufficiently hard and will not be damaged by removal, and the concrete has attained sufficient strength to ensure structural stability, carry dead loads and any construction loads which may be imposed upon it.

END OF SECTION

REINFORCING STEEL

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, welding, materials, equipment, and services necessary for the installation of reinforcing steel.

B. The Structural General Structural Notes shall be used in conjunction with these specifications. The General Structural Notes shall supersede items in this specification when discrepancies exist.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. American Welding Society (AWS).

C. Concrete Reinforcing Steel Institute (CRSI).

D. American Concrete Institute (ACI).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Placing drawings and bar lists showing quantities, sizes, dimensions, bends, applicable details, spacing of bars, and location of splices.

C. Steel shall be marked and identified when it arrives at the project. Provide mill certificates for each lot and make available to Architect upon request.

PART 2 PRODUCTS

2.1 MATERIALS

A. Unless noted on the Drawings, all reinforcing steel shall conform to ASTM A615 Grade 60 or ASTM A706 Grade 60.

B. Bar and rod mats for concrete reinforcement conforming to ASTM A184.

C. Cold drawn wire reinforcement conforming to ASTM 82.

D. Plain smooth dowels and 1/4-inch diameter smooth bars conforming to ASTM A615 Grade 60.

E. Tie wire shall be 16 gauge or heavier black annealed wire.

F. Welded wire fabric electrically welded, gauge and mesh size as detailed, conforming to ASTM A1064.

G. Bar supports shall conform to the CRSI Manual of Standard Practice, Chapter 3, Bar Supports.

H. Reinforcing bars to be embedded in concrete shall be free from oil, loose mill scale and rust. Reinforcing bars with rust, mill scale or a combination of both will not be acceptable without cleaning or brushing provided that upon wire brushing a sample, the dimensions including height of deformations and weights shall not be less than the applicable ASTM requirements.

2.2 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) – Manual of Standard Practice, ACI SP-66 – ACI Detailing Manual, and ACI 318.

B. Welding of reinforcement is not permitted unless otherwise noted on the Drawings.

C. Locate reinforcing splices not indicated on drawings at point of minimum stress.

PART 3 EXECUTION

3.1 INSTALLATION

A. Details of concrete reinforcement not covered in the Drawings and these Specifications shall be in accordance with the CRSI Manual of Standard Practice.

B. Reinforcing bars shall conform accurately to the dimensions detailed and be within the standard fabricating tolerances.

C. Unless otherwise noted on the Drawings, bend all hooks using the pin diameters and dimensions detailed as ACI Standard Hooks.

D. Do not bend or straighten reinforcing bars in a manner that will injure the material.

E. Place bars in conformance with the CRSI Manual of Standard Practice.

F. Securely tie bars to prevent displacement during the pouring operation. Wire dowels in place before depositing concrete.

G. Install reinforcing bar splices as detailed.

H. Minimum Clear Thickness of Concrete Over Bars:

1. 3 inches at earth formed or surfaces bearing on earth.

2. 1-inch at faces of slabs.

3. 1-1/2-inches at walls exposed to earth and weather with #5 and smaller reinforcing bars. 2-inches at walls exposed to earth and weather with #6 and larger reinforcing bars.

4. 3/4-inch at interior face of walls.

I. Welding of reinforcing bars only as approved by the Architect shall be performed in accordance with AWS D1.4, Structural Welding Code - Reinforcing Steel, ASTM A706 Grade 60.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections: The Owner will employ the services of an independent testing laboratory to conduct inspection services on all reinforcing steel placement.

END OF SECTION

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the installation of cast-in-place concrete, including mixing, delivery and placement; finishing, curing, and sealing; and tests, reports, and records of inspection as required.

B. The General Structural Notes shall be used in conjunction with these specifications. The General Structural Notes shall supersede items in this specification when discrepancies exist.

C. Related Sections:

1. Division 3 Sections “Concrete Forming and Accessories,” and “Reinforcing Steel.”

2. Division 31 Sections “Concrete Paving,” and “Concrete Curbs, Gutters, and Walks.”

1.2 REFERENCES

A. American Concrete Institute (ACI). Unless noted otherwise, all references to ACI documents shall conform to current building code adopted section or most current section if not adopted by current building code.

B. American Society for Testing and Materials (ASTM).

1. ASTM C33, Standard Specification for Concrete Aggregates.

2. ASTM C39, Standard Specification for Ready-Mix Concrete.

3. ASTM C143, Test for Slump of Portland Cement Concrete.

4. ASTM C150, Standard Specification for Portland Cement.

5. ASTM C260, Standard Specification for Air-Entraining Admixtures for Concrete.

6. ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

7. ASTM C494, Standard Specification for Chemical Admixtures for Concrete.

8. ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

9. ASTM C685, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.

10. ASTM C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

11. ASTM C1059, Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

C. Northwest Wall and Ceiling Bureau.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Manufacturer’s printed product data of concrete additives, curing compounds, waterstops, and sealers, clearly marked to indicate selected products.

C. Manufacturer’s "Full System" 15-year warranty on flooring materials and labor for interior curing compound.

D. Mix designs for all specified mixes, 14 days before any concrete placement, including manufacturer’s product data for all admixtures and amounts per yard. Submittals shall conform with ACI 318, Chapter 5, requirements for mix designs. Sample standard deviation shall be calculated per ACI 318 section 5.3.1.1 or 5.3.1.2. Documentation of average compressive strength shall also be submitted and approved per ACI 318-11 section 5.3.3.1.

E. Copies of laboratory test reports on the compressive strength of test cylinders made with each mix proposed for use.

F. Copies of certificates prepared by the concrete supplier stating that the approved additives were added to each batch of concrete delivered to the site. Certificates shall also state, if applicable, amount of water which was withheld at the batch plant for inclusion at the site. Each certificate accompanied by one copy of each batch delivery ticket indicating the trade name, manufacturer’s name, and amount per cubic yard of material added.

G. Construction Joint Shop Drawings: Indicated proposed construction joint locations for all concrete pours to be reviewed by the Architect.

H. Slab Control Joint Shop Drawings: Indicate proposed slab on grade control joint locations to be reviewed by the Architect.

1.4 QUALITY ASSURANCE

A. Perform all work of this section in accordance with ACI 301 and ACI 318.

B. Follow recommendations of ACI 306R when concreting during cold weather.

C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA’s “Certification of Ready Mixed Concrete Production Facilities.”

D. Pre-Installation Conference: Schedule and administer pre-installation conference to review finishing techniques of concrete, use of additives, and application of curing compounds with attending Architect, job superintendent, independent test lab representative, concrete supplier, and concrete finishing subcontractor. Include inspection of the vapor barrier for proper joint seals and no unsealed penetrations.

E. Tolerances for concrete construction and materials shall conform to all requirements of ACI 117-10, unless more stringent requirements are part of this specification.

1.5 WARRANTY

A. When a glue-down floor covering system is installed on a slab treated with interior slab curing compound according to curing compound manufacturer's instructions, the manufacturer shall warrant the floor covering system against delamination due to negative-side, ground-originated moisture migration or moisture-borne contaminants for a period of 15 years from the date of original installation. The warranty shall cover labor and materials necessary to repair or replace the floor covering system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed below.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I, low alkali for all concrete Work.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: ASTM C1602, clean and not detrimental to concrete. Do not add water to mix at project site unless letter from concrete supplier is obtained documenting amount of water withheld from mix to be added at project site.

D. Admixtures:

1. All admixtures produced by the same manufacturer to ensure compatibility of the products. Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete or as indicated within the drawings or specifications. Do not use calcium chloride or admixtures containing calcium chloride.

2. Air Entraining Agent:

a. ASTM C260. Air content held within ±1% for up to one hour from batching. Provide in all exterior concrete at 4% to 6%.

b. Products:

(1) "Daravair-1000" or "Darex II AEA" by Grace Construction Products.

(2) "Micro Air" or "MBAE-90" by Master Builders.

3. Water Reducing Admixture:

a. ASTM C494, Type A. All concrete shall contain a Type A admixture in the basic design with dosages high enough to reduce water by at least 10% from the same mix without the admixture. This admixture shall produce no retardation.

b. Products:

(1) "Zyla 630" by Grace Construction Products.

(2) "Polyheed" by Master Builders.

4. High Range Water Reducing Admixture (Superplasticizer):

a. ASTM C494, Type F. Batch plant added, extend rheoplastic time, maintain setting characteristics similar to normal concrete throughout the recommended dosage range at varying concrete temperatures, reduce water 15% to 40%, and give higher early and ultimate strengths. Use of this product is Contractor’s option, except as required by Division 3 Section "Architectural Concrete."

b. Products:

(1) "ADVA 195" by Grace Construction Products.

(2) "Rheobuild 1000" by Master Builders.

(3) "Polyheed" by Master Builders, used at 10 oz./100 lbs. of cementitious material or greater. Dosage of approved mixes can be increased to over 10 oz. and meet the requirements for superplasticizer use.

5. Accelerating Admixture:

a. ASTM C494, Type E. Do not use chloride in its manufacture. Use of this product is Contractor’s option.

b. Products:

(1) "Daraset" by Grace Construction Products.

(2) "Pozzutec 20" by Master Builders.

6. Retarding Admixture:

   a. ASTM C494, Type D. Do not use retarder without the Architect's approval. Submit written proposed details of use.

   b. Products:

      (1) "Daratard-17" by Grace Construction Products.

      (2) "Pozzolith 100 XR" by Master Builders.

7. Freeze Protection Admixture:

   a. At the Contractor's option, add ASTM C494, Type E, admixture, specially formulated to give protection from freezing down to 20°F may be used at the admixture manufacturer's required dosage to place concrete in ambient temperatures as low as 20°F (-7°C) until initial set has been reached. Provide manufacturer's certification that this admixture will protect the concrete from freezing when used per their written instructions.

   b. Products: "Pozzutec 20" by Master Builders at 60 oz. to 90 oz./100 lbs. of cementitious material.

E. Fly Ash:

1. May be used at Contractor's option to replace up to 20% (limit to 15% at polished concrete) of cement content, provided the mix design strength is substantiated by test data.

2. Conform to ASTM C618, including Table 24, Class F.

3. Ground granulated blast furnace slag (slag cement) conforming to ASTM C-989 and AASHTO M-302, Grade 100.

F. Hot Weather Finishing Aid:

1. Specially formulated material to be sprayed on fresh concrete to prevent rapid drying during hot and windy weather. Sprayed over plastic concrete, finishing aid produces a monomolecular film that holds the water in until the next finishing operation. Product contains a yellow fluorescent color tint to easily identify the areas covered.

2. Products: "Confilm" by Master Builders.

G. Curing Paper and Sheet Covering: ASTM C171, waterproof paper, polyethylene film, and burlap polyethylene sheet.

H. CUR-1, Curing Compound for interior slabs on grade scheduled to receive glue-down floor covering:

1. Silicate-based solution with minimum 34% solids content.

2. One coat application at 200 s.f./gallon.

3. Products:

   a. CreteSeal CS2000 water-based cure and seal compound, 800-278-4273.

   b. Curranseal PMC3300 water-based cure and seal compound, 714-641-1121.

I. CUR-2, Curing Compound for exterior slabs, and slabs-on-grade not scheduled to receive glue-down floor finish:

1. ASTM C309, Type 1. One coat application at coverage rate of 200 s.f./gallon.

2. Products:

   a. "Masterkure 200W" water base curing compound by Degussa Building Systems.

   b. "VOCOMP-20" by W.R. Meadows.

   c. "Hydro Cure 309" by Unitex.

   d. "Conspec RX Cure WB" by Dayton Superior.

J. Expansion Joints:

1. ASTM D1751. 1/2-inch thick expansion joint (slabs, sidewalks, curbs, and pavements) for interior and exterior, with gray joint sealant.

2. Joint Sealant Products:

   a. "Eternaflex" by Gibson-Homans two-part urethane joint sealant.

   b. "Masterfill 300" by Master Builders.

   c. "Sikaflex-1a NS/SL" by Sika.

   d. “Pourthane SL” by W.R. Meadows.

K. Slab Isolation Joints: 1/2-inch thick polyurethane foam.

L. Cold Joint Form: Straight joints of metal or wood.

M. CS-1, Concrete Sealer:

1. Water base acrylic concrete sealers.

2. Products:

a. "Aqua-Cure VOX" by Euclid.

b. "VOCOMP-25" by W.R. Meadows.

c. "Hydro Seal 18" by Unitex.

N. Protection Board: 1/2-inch by 4-feet by 8-feet APA CDX plywood.

2.3 REPAIR MATERIALS

A. Repair Overlayment and Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.4 CONCRETE MIX DESIGN

A. Contractor’s Option:

1. Before ordering concrete, submit four copies of previously used and tested design mixes meeting the requirements of ACI 301, using aggregates, admixtures, and cement/fly ash intended for use in this concrete, to Architect for review and approval for use in this Work.

2. Laboratory designed mix strength used as a basis for selecting proportions of ingredients for concrete exceeds the minimum specified design strength by the amount required by ACI 301, but not less than 500 psi. Comply with ACI 211.1 recommendations.

B. Show dry weight of cement, fly ash, saturated-surface-dry weights of fine and coarse aggregate, quantities of admixtures, W/C ratio, slump, air content, and the unit weight per cubic yard of concrete. Submit a separate design mix for each design mix number required in this Work.

C. Manufacturer is fully responsible for the selection of proportions for the concrete mix, ASTM C94 and ACI 301.

D. Mix Design 1:

1. 28-day minimum compressive strength of 4000 psi per ACI 301.

2. ASTM C33 fine aggregate and size No. 67 (3/4-inch to No. 4) coarse aggregate.

3. Maximum 4-inch slump, maximum water/cement 0.44 non-air entrained, 0.35 air entrained.

4. Include additives as specified.

E. **Mix Design 2:**

1. **28-day minimum compressive strength of ?? psi per ACI 301 for bearing walls and columns.**

2. **ASTM C33 fine aggregate and size No. 67 (3/4-inch to No. 4) coarse aggregate.**

3. **Maximum 4-inch slump, maximum water/cement 0.45.**

4. **Include additives as specified.**

F. Mix Design 2 (Slab-on-Grade Concrete Only): Same as Mix Design 1, except minimum cement of 564 lbs./cu.yd. and maximum water/cement ratio 0.42.

A. Limit water-soluable, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

PART 3 EXECUTION

3.1 CONCRETE MIXING

A. Ready-Mixed Concrete:

1. Use only ready-mixed concrete obtained from plant approved by the Architect, mixed and delivered in conformance with the approved design mix. Obtain a delivery ticket for each batch of concrete delivered to the job.

2. Maintain a file of all delivery tickets at the job site, in good order, available for inspection by Architect at all times. Include the following information: Name of ready-mix batch plant; serial number of ticket; date and truck number; Contractor's name; job name, and location (address); amount of concrete in batch (cubic yards); mix type number; location placing on job; and name, quantity and type of admixtures.

B. Add all ingredients to the concrete at the batch plant during the mixing time. This includes all cement, fly ash, aggregate, water, and admixtures.

C. Do not add water to the concrete mix at the Project Site unless it is specifically noted on the batch ticket that water was withheld at the batch plant for inclusion at the Project Site. The special inspector shall approve any water addition at the Project Site.

D. Mix concrete in strict accordance with admixture manufacturer's instructions and recommendations for uniform and complete distribution.

3.2 CONCRETE PLACEMENT

A. Place concrete in accordance with ACI 304R.

B. Place concrete floor slabs in accordance with ACI 302.1R.

C. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

D. Thoroughly soak wood forms or coat with release compound before pouring concrete. Dampen earth bottoms to reduce moisture loss from concrete.

E. Deposit concrete as near to the final position as possible to avoid rehandling or movement by vibrators. Insert the vibrator within 2 feet of the point of placement as the concrete is being placed. Place the concrete in uniform, horizontal layers not exceeding 24 inches in height after consolidation. Avoid vertical joints or inclined planes. The piling up of concrete in forms in such a manner as to permit the mortar to escape or to necessitate the lateral flow of the concrete will not be permitted. Deposit concrete continuously and as rapidly as practical until the entire unit of pour is completed.

F. In ambient temperatures over 80°F, pour concrete within 90 minutes of being mixed.

G. Provide hoppers and elephant trunks to place concrete in deep forms without exceeding 6 feet maximum free fall. Establish pour lines to occur only at feature lines or as approved by the Architect.

H. Whenever it is necessary to discontinue pouring prior to the complete filling of the forms, and a horizontal construction joint occurs, or when concrete has been permitted to set for two hours or more, such joints shall be roughened, cleaned, wetted and slushed with a neat 50% sand/50% cement grout immediately before additional concrete is placed. Refer to Division 3 Section "Concrete Forming and Accessories," for requirements of reveal joints in exposed concrete surfaces.

I. Do not deposit concrete that has partially hardened or been contaminated by foreign material nor use retempered concrete.

J. Concrete placed in ambient temperatures of 50°F down to 40°F may be treated with the specified accelerating admixture. Do not add calcium chloride to the concrete.

K. Do not place concrete when weather forecast predicts temperatures below 40°F within succeeding 24 hours without approval of Architect. When approval is granted for placing of concrete during times when temperature is below 40°F, follow all of the requirements of ACI 306.1, Cold Weather Concreting, or, at the Contractor's option, use the specified freeze protection admixture at 60 oz./100 lbs. of cement in the mix, per manufacturer's written instructions, without doing the protection required in ACI 306.1.

L. Cold Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 degrees F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

M. Hot-Weather Placement: Comply with ACI 305.1 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

N. Protect slab-on-grade concrete from rapid drying and wind regardless of temperature.

3.3 CONCRETE SLAB-ON-GRADE JOINTS

A. Contraction Joints: Provide contraction joints as detailed and as follows:

1. Locate contraction joints along column lines and as needed to divide the slabs into small rectangular areas such that the ratio of long to short side does not exceed 1.25. Avoid odd shapes if possible and reinforce re-entrant corners to avoid cracking.

2. **Space contraction joints at 24 to 36 times slab thickness in both directions at exterior slabs and a maximum of 12 feet both directions for interior slabs.**

3. **Saw cut contraction joints a depth equal to 1/4 slab thickness. Other contraction joint types shall be approved by the Architect. Cut joints within ____ hours of slab pour.**

4. Keyed Contraction Joints: Provide full-depth keyed joints of preformed metal forms where noted on the Drawings.

5. Doweled Construction Joints: Provide doweled joints using smooth bars spaced equally, perpendicular to the joints, and centered in the slab thickness. Coat the bars with grease or wrap with bond-breaker tape. Provide in locations as noted on the Drawings.

B. Expansion/Isolation Joints:

1. Provide expansion/isolation joints where detailed and as follows:

2. Locate in slabs on grade to isolate vertical and horizontal movement between slabs and adjoining structures such as walls, columns, footings, or specially loaded areas such as machinery bases.

3. Maintain clean isolation joints free of all bridging elements. Remove debris, concrete, and other materials that bridge isolation joints."

C. Construction Joints: Coincide construction joints with contraction and isolation joints where possible. Key or dowel the joint as required. Where construction joints do not coincide with contraction and isolation joints, provide bonded dowel joints at heavily loaded slabs and butt joints at lightly loaded slabs in accordance with ACI 224.3R-95.

D. Install joint filler in joints as detailed and seal all joints with joint sealant in accordance with sealant manufacturer's instructions.

3.4 COMPACTION

A. Concrete may be placed as flowable concrete at Contractor's option (6-inch slump with admixtures). Flowable concrete requires only 1/4 of the vibration of 3-inch to 4-inch slump concrete.

B. Vibrate all concrete, or work by hand where vibration cannot be used to assure close contact with all surfaces of the forms and reinforcement, and leveled off at proper grade to receive finish. Vibrate for sufficient duration to accomplish thorough compaction and complete embedment of reinforcement but not long enough to cause separation of the mix. Keep the vibrator away from the architectural surface of the form at least 3 inches. When there is a single steel reinforcing cage stay on the other side of the steel from the architectural exposed side. Where there are two steel cages, insert the vibrator in between the steel and not on the form side.

C. The vibrator shall be either motor-in-head type with 180 cycle generators or 2-1/2 h.p. motor-on-shaft type with length not exceeding 12 feet. Motor-in-head units with 60-cycle power or similar sources will not be used. The vibrator is subject to approval of the Architect. 10,000 impulses per minute minimum frequency. Be thoroughly familiarized with all requirements and discussion of the vibrator selection included in ACI 309, Consolidation of Concrete. General use of vibrators for this construction shall have heads from 2-1/4 inches to 2-5/8 inches in diameter and 16-inches in length.

D. Top out all concrete with a lesser powered vibrator, not to exceed 12 inches in length, to remove air pockets from the top portion of the casting. This will be done only after the other compaction is completed. The specified high-energy vibrators have a tendency to churn air into the top of the concrete. In no case will the vibrator be allowed to be partially exposed from the concrete surface. When partial exposure occurs, the vibrator will be immediately extracted.

3.5 PROTECTION AND CURING

A. Comply with the requirements of ACI 308.1.

B. Protect concrete finishes against injury from the elements and defacements of any nature during construction operation.

C. When concrete slabs have received their finish, and as soon as the surface water subsides, coat the entire surface with curing compound applied at a rate recommended in the manufacturer's written instructions.

D. Keep all unformed and exposed surfaces of footing pads, grade beam footings, columns and walls continuously moist for at least seven days and at a minimum temperature of 40°F. Concrete placed with freeze protection admixture may be cured with 20°F as the minimum temperature. Keep wood forms wet during curing period and spray wood and metal forms to cool when exposed to heating by sunlight or hot winds; or loosen forms and apply water directly to concrete. Moist-cure formed work as forms are removed during curing period.

E. Cover with curing paper and sheets in lieu of curing compounds whenever protection from rapid drying by sunlight or atmospheric temperature and low humidity is required. Cure slabs by covering with curing paper or moist cure whenever finish is to receive a sealer coat, decoration coat, or other applied finish not compatible with curing compound. Use moist curing on structural slabs receiving synthetic floor surfacing.

3.6 CONCRETE FINISHING

A. Formed Concrete Faces:

1. Finish exposed formed concrete faces straight, plumb, and true, with a variation of no more than 1/8-inch in 10 feet measured in any direction, non-cumulative.

2. Cut back all form ties, nails, etc. If tie holes are to be exposed, verify pattern and location with the Architect. Fill bottom of exposed tie holes with sealant, as specified in Division 7 Section "Joint Sealants."

3. **Apply a grout cleaned, sacked finish or portland cement skim coat to exterior exposed formed faces which are not scheduled to receive another finish. Conform to ACI or Northwest Wall and Ceiling Bureau approved and recommended methods to produce a smooth, even surface, free from marks, lumps, depressions or unevenness of any kind.**

B. Slabs:

1. Verify that no vapor barrier damage has occurred since the pre-installation inspection. Repair all damage to achieve complete and continuous vapor barrier membrane.

2. Remove water from vapor barrier with portable high-speed air blowers just prior to slab-on-grade pour.

3. All interior slabs on grade shall contain superplasticizer and water reducing admixture.

4. Do not start slab concrete during or when it may be exposed to rain; do not continue during such weather unless suitable protection is provided. Predetermine cut-off points

before commencing Work, and confine to expansion or construction joints. Expansion joints and construction joints located as shown on the Drawings or, if not shown, according to reference standards.

5. Set screeds, forms for construction joints, and isolation joints, and place 30 lb. roofing felt bond breaker strips continuously at joints with footings and walls and at rigid construction penetrating floor slabs. Set screeds accurately with a builder's telescope level or transit and without penetrating the vapor barrier. The slabs shall be level unless specifically noted otherwise.

6. Floor slabs to be monolithic construction, of thickness and reinforced as detailed. Place reinforcing bars in conformance with the Drawings.

7. Slab concrete shall be of a flowable consistency, well tamped into place, and finishes compressed and compacted by troweling. Finish slab free from small hollows or bumps and graded to the elevations called for, with depressions in floors between high spots not greater than 1/4-inch below a 10-foot straightedge in accordance with ACI 117 and ACI 302 Slab Finishing Class 2, and not vary more than 5/16-inch between opposite exterior walls, unless otherwise called for on the Drawings.

8. Finish surfaces to the following tolerances, according to ASTM E1155:

   a. Specified overall values of flatness F(F) 35 and of levelness F(L) 25 with minimum local values of flatness, F(F) 24; and of levelness F(L) 17 for slabs on grade.

   b. Concrete slabs scheduled to receive a polished finish shall have a Floor Flatness rating of at least 40 and a Floor Levelness rating of at least 40.

9. Where drainage is called for, maintain even drainage from the wall of the room to the drain. Accurately pitch floor to the drains in accordance with the Drawings and drainage requirements of the room. Floors that do not drain properly into drains will be rejected and be replaced at Contractor's expense.

10. Wood float finish surfaces especially scheduled and when slab receives mortar bonded ceramic tile. Refer to Drawings for areas that may require depressed slab surfaces.

11. Exposed formed joints and edges, finished with concrete finisher's edgers, jointers and bullnose tools. Produce straight, compacted, and smoothly finished work, using straightedge tool guide wherever possible. Form a 3/8-inch radius bullnose finish to outside edges and corners unless detailed otherwise.

12. Sprinkling or adding water to the slab surface during finishing will not be permitted. In drying conditions use the specified "Hot Weather Finishing Aid" to prevent plastic finish cracking and reduce labor and time in finishing operations.

C. Plain Slabs:

1. These slabs are indicated on the Finish Schedule as "CS-1," acrylic concrete sealer

2. Prior to final set, finish slabs with power tools to a dense hard, uniform steel trowel surface. Hand trowel at edges as required and apply curing compound.

3. Protect concrete finish floor slabs from stains, differential curing discoloration, craze cracks, and other finishing defects which will be visible through sealer coat or result in non-uniform appearance. Cover with protection board.

D. Slabs Under Floor Covering:

1. After wood floating and before final set occurs, steel trowel with proper tools to provide a dense, hard, uniform surface. Finish hand troweling at edges of slab as required and apply curing compound.

2. Concrete floor slabs receiving carpeting, resilient floor covering or other applied finishes shall be free of defects which will show through as noted above. Apply CUR-1 in accordance with curing compound manufacturer’s instructions for compliance with warranty requirements.

3.7 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements. Surface defects that include honeycomb, rock pockets, indentations greater than 3/16 inch, cracks 0.010 inch wide and larger, spalls, chips, air bubbles greater than 3/4 inch diameter, pinholes, bug holes, embedded debris, lift lines, sand lines, bleed lines, leakage from form joints, fins and other projections, form popouts, texture irregularities, and stains and other color variations that cannot be removed by cleaning. Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off even with surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair overlayment. Cut out low areas to ensure a minimum repair overlayment depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.8 CONCRETE FLOOR SEALING

A. See Finish Schedule for new and existing exposed concrete floors to be sealed. Sealing floors with glazed surface coating to be done after overhead work and painting is done and just before final inspection.

B. Remove protection board and clean floor slabs by lightly machine sanding with number 3-1/2 grit to remove all grease, paint, taper's putty, and other foreign matter. Thoroughly vacuum clean area, using heavy-duty commercial vacuum cleaner to remove all dust and dirt.

C. CS-1, Concrete Sealer:

1. Apply acrylic sealer immediately after cleaning by either spray or roller at rate of 350 to 400 s.f./gallon without holidays or puddling.

2. Sealed surface to be uniformly coated and even appearing, free from visible stains and evidence of uneven application. Correct defective areas by additional sanding and reapplication of sealer.

3.9 MANUFACTURER'S FIELD SERVICE

A. Provide the services of a qualified technical representative of the product manufacturer to instruct the concrete supplier in proper batching and mixing of materials for admixtures.

B. Provide the services of a qualified technical representative from the interior curing compound manufacturer to instruct the concrete finisher in the proper application of the interior curing compound.

3.10 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Use ACI Standard Specification for Structural Concrete for Buildings, ACI 301 for all concrete Work. Inspect placing and condition of reinforcing before placing concrete.

2. The Owner will employ the services of an Independent Testing Laboratory (ITL) for taking of tests and to conduct inspection services. Cooperate with the Testing Laboratory and provide storage for shipping boxes, cylinder molds, and assist in storage and shipping of cylinders. Reference requirements of structural drawings and Statement of Special Inspections within the structural drawings for all required inspections and testing in addition to this specification.

3. Give Architect and testing laboratory 24 hours advance notice before starting work requiring inspections and tests.

4. Inspection includes placing and finishing of concrete Work to ensure workmanship, control of materials and compliance with the Specifications.

5. For each day's pour of each concrete mixture, make four standard 6-in by 12-in compression test cylinders for testing complying with ASTM C31 and obtained according to ASTM C172. Test one at seven days, one pair at 28 days, and one "hold cylinder" on every 150-cu.yd. of concrete or 5000-sf of surface area for slabs and walls placed or each day's pour if less than 150-cu.yd. Compression test cylinders will not be required for minor non-structural pours of less than 10-cu.yd. per day if prior approval of Architect is obtained.

6. A slump, air content, and unit weight test will be made when cylinders are taken. Contractor shall maintain a slump test cone on the site at all times for intermittent slump tests as requested.

7. Concrete in pours which do not attain the specified strength may be rejected and must be replaced if so ordered.

8. Submit ITL written reports on all tests and inspections made, to the Architect, ready-mix producer, and other offices as directed by the Architect.

9. Evaluation of Test Results: If the results of this testing show that any part of the structure contains material which is below the requirements called for by these Specifications, that portion of the Work will be subject to condemnation by the Architect. Remove and replace any Work so condemned by the Architect as directed by the Architect.

10. Load and Core Tests: Make load tests per ACI 318, core tests and such other tests as the Architect may deem necessary, at Contractor's expense for the following reasons:

    a. Average 28-day strength of any pair of test cylinders more than 500 psi below design strength.

    b. Average 28-day strength of three consecutive pair of test cylinders below design strength.

    c. Evidence of uncured frozen concrete.

END OF SECTION

POLISHED CONCRETE FLOOR FINISH

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes polishing concrete to specified finish level, and applying sealer and hardener.

B. Related Sections:

1. Division 3, Section "Cast-In-Place Concrete."

1.2 REFERENCES

A. American Society for Testing and Materials:

1. ASTM-C779, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.

2. ASTM G23-81, Ultraviolet Light & Water Spray.

3. ASTM C805, Impact Strength.

B. American Concrete Institute: ACI 302. 1R-89, Guide for Concrete Floor and Slab Construction

C. Voices of Safety International: VOSI V41.21 test method.

D. Other Test: Reflectivity.

E. Concrete Polishing Association of America.

1.3 PERFORMANCE CRITERIA

A. Abrasion Resistance: ASTM C779, up to 400% increase in abrasion resistance.

B. Impact Strength: ASTM C805, up to 21% increase impact strength.

C. Ultra Violet Light and Water Spray: ASTM G23-81, no adverse effect to ultra violet and water spray.

D. Reflectivity: Up to 30% increase in reflectivity.

E. Slip Resistance of Polished Concrete: Provide minimum 0.8 static coefficient of friction to qualify as a slip resistant surface per Voices of Safety International VOSI V41.21 test method.

1.4 SUBMITTALS

A. Submit the following in accordance with Division 1, Section "Submittal Procedures."

B. Product Data:

1. Submit special concrete finishes manufacturer's specifications, test data and other data required for each type of manufactured material and product indicated.

2. Submit special concrete finishes describing product to be provided, giving manufacturer’s name and product name for the specified material proposed to be provided under this Section.

3. Submit special concrete finishes manufacturer's recommended installation procedures which, when reviewed by the Architect, may become the basis for accepting or rejecting actual installation procedures used on the work.

4. Submit special concrete finishes technical data sheet giving descriptive data, curing time, and application requirements.

5. Submit special concrete finishes manufacturer’s Material Safety Data Sheet (MSDS) and other safety requirements.

C. Test Reports: Provide certified test reports, prepared by an independent testing laboratory, confirming compliance with specified performance criteria.

D. Samples: Each floor has its own unique appearance when completed. Provide manufacturer’s lab samples only to show a smooth shiny surface. The final appearance of a finished floor cannot be guaranteed to match a sample due to the natural variations in concrete.

E. Manufacturer’s Certification: Provide letter of certification from concrete finish manufacturer stating that installer is certified applicator of special concrete finishes, and is familiar with proper procedures and installation requirements required by the manufacturer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Use a certified installer and adequate number of skilled workmen who are thoroughly trained and experienced in the necessary craft.

2. The special concrete finish manufacturer shall certify installer.

3. Installer shall be familiar with the specified requirements and the methods needed for proper performance of work of this Section.

4. The installer shall have successfully performed a minimum of five projects of at least 5000 square feet each with polishing/hardener-sealer combination.

B. Mock-ups:

1. Apply one mock-up to demonstrate typical joints, surface polish to 400 grit, exposed aggregate size, color variation and standard of workmanship. Adjust polish level as required by Architect’s review of mock-up.

2. Build mock-up of approximately 50 square feet each on a floor scheduled to receive another floor covering finish and in the location as directed by the Architect. Mock-up shall include polishing of inside corners and up to vertical obstructions.

3. Notify Architect seven days in advance of dates and times when mock-up will be constructed, when practical.

4. Obtain approval of mock-up from the Architect before starting actual work.

5. Maintain mock-up during construction in an undisturbed condition as a standard for judging the completed work.

C. Protection of concrete floors prior to and after finishing:

1. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.

2. All hydraulic powered equipment must be diapered to avoid staining of the concrete.

3. No trade shall park vehicles on the inside slab. If necessary to complete their scope of work, drop cloths shall be placed under vehicles at all times.

4. All equipment shall be equiped with non-marking tires.

5. No pipe cutting machine shall be used on the inside floor slab.

6. Steel shall not be placed on interior slab to avoid rust staining.

7. Acids and acidic detergents shall not come into contact with slab.

8. All trades informed that the slab must be protected at all times.

D. Pre-Installation Conference: Conduct conference at project site to comply with requirements in Division 1, Section " Project Management and Coordination."

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original containers, with seals unbroken, bearing manufacturer labels indicating brand name and directions for storage.

B. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.

1.7 PROJECT CONDITIONS

A. Environmental limitations: Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.

1. Concrete must have a Floor Flatness rating of at least 40.

2. Concrete must have a Floor Levelness rating of at least 40.

3. Concrete must be cured a minimum of 28 days or as directed by the manufacturer before application of hardener-sealer can begin.

B. Application of hardener-sealer shall take place 10 days prior to installation of equipment and substantial completion, thus providing a complete, uninhibited concrete slab for application.

C. Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.

D. Provide disposal of slurry and finish by-products in compliance will all applicable codes.

1.8 WARRANTY

A. Provide manufacturer and Certified Applicator combined Ten Year Material and Labor warranty stating that structurally sound treated surface will remain hardened, dust proof and water repellant.

PART 2 PRODUCTS

2.1 MATERIALS AND MANUFACTURERS

A. Hardening/Sealing Agent:

1. Advanced Floor Products, Inc. 801/812-3420, "Retro-Plate 99."

2. Certified Applicator: As approved by manufacturer.

3. Manufacturer's Regional Representative: Ron Ogden, 206-498-4075.

B. Related Materials:

1. Water: Potable.

C. Maintenance Cleaner: Provide one gallon of CreteClean Plus with ScarGuard and maintenance instructions.

D. Joint Filler: Cretefill Pro 75 polyurea joint filler.

E. Stain Prevention: Advanced Floor Products, Inc. “RetroGuard” modified acrylic sealer for protecting concrete surfaces against oil and food staining.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.

B. Verify that concrete slabs meet finish and surface profile requirements in Division 3 Section "Cast-In-Place Concrete," and Project Conditions above.

3.2 APPLICATION

A. Floor to be prepared for hardener-sealer application with specified diamond grinding steps, followed by the application of hardener-sealer and final polishing steps. Floors shall be polished up to walls and other obstructions. There shall be no boarder of unpolished concrete at floor edges.

B. Polish to level as determined by Architect from mock-up review. Remove all scratch patterns from previous grit with each level of finer grit. Start any of the floor finish applications in presence of manufacturer's technical representative.

C. Apply concrete floor finish in accordance with manufacturer's instructions.

D. Sealing, Hardening and Polishing of Concrete Surface:

1. Concrete must be in place a minimum of 28 days or as directed by the manufacturer before application can begin.

2. Application of hardener-sealer shall take place 10 days prior to installation of equipment and substantial completion, thus providing a complete, uninhibited concrete slab for application.

3. Only a certified applicator shall apply hardener-sealer. Applicable procedures shall be followed as recommended by the product manufacturer and as required to match approved test sample.

4. Achieve waterproofing, hardening, dust-proofing and abrasion resistance of the surface without changing the natural appearance of the concrete, except for the sheen.

5. Polish to pre-determined level based on test sample.

E. Final Protection of Polished Concrete: Following completion of the final polishing, surface shall be covered to protect from other trades. Cover with durable breathable product, such as breathable Homasote. Do not cover with masonite, plywood or visquine. Floor must be allowed to breath during final curing.

F. Stain prevention coating's application method and timing of application shall be in accordance with product manufacturer's printed instructions.

3.3 WORKMANSHIP AND CLEANING

A. The premises shall be kept clean and free of debris at all times.

B. Remove spatter from adjoining surfaces.

C. Repair damages to adjacent surfaces caused by cleaning operations.

D. Dispose of materials in accordance with local regulations.

3.4 PROTECTION

A. Protect finished work until fully cured in accordance with manufacturer's recommendations.

END OF SECTION

GYPSUM CEMENT UNDERLAYMENT

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services necessary for the installation of the poured-in-place, self-leveling, lightweight gypsum cement underlayment where scheduled and detailed on the Drawings.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section “Submittal Procedures.”

B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on mixing instructions.

C. Manufacturer’s printed test data demonstrating compliance with sound and fire rating performance requirements.

D. Qualification data for qualified installer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: All work shall be performed by qualified, experienced installers approved and certified by the lightweight concrete underlayment manufacturer using approved mixing and pumping equipment.

B. Fire-Resistance Ratings: Where indicated, provide gypsum-cement underlayment systems identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate Gypsum Association Assembly design designations as noted on the floor/ceiling assemblies detailed in the Drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered in manufacturer's original undamaged packages or acceptable bulk handling equipment. Store material in area protected from exposure to elements. Remove all damaged or deteriorated material unsuitable for use from the job site and replace with undamaged material.

1.6 PROJECT CONDITIONS

A. Schedule installation of underlayment as late as possible during construction to avoid damage from other trades working in area.

B. Installation not permitted until building interior is enclosed and maintained at a temperature of 50°F or above and until structure and subfloor temperatures are stabilized. Provide ventilation to eliminate excessive moisture.

C. Maintain stabilized ambient temperatures in area after application to prevent damage from sudden thermal changes during and after application.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Specification is based on “Green LevelRock 3500” gypsum floor underlayment system manufactured by US Gypsum Corp., 800-874-4968.

B. Other Approved Manufacturers: Subject to compliance with requirements of this specification, equal products by the following manufacturers are approved:

1. Hacker Industries, Inc.

2. Maxxon Corp.

C. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section “Product Requirements.”

2.2 MATERIALS

A. Cement: “LevelRock 3500 Green Floor Underlayment,” gypsum cement underlayment compound:

1. Minimum compressive strength 3500 psi. ASTM C472. Products with range of compressive strength below 3000 psi are not acceptable.

2. Minimum density 120 pounds per cubic foot.

3. Recycled Content: Minimum 85% post-industrial content.

B. Sand: Clean, fine graded plastering or masonry sand conforming to ASTM C144.

C. Finish Sealer: Ardex “P51Primer,” solvent-free primer.

2.3 MIXING

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

B. Mix to achieve following characteristics:

1. Density: 120 lb/cu ft minimum dry density.

2. Compressive Strength: 3,500 psi minimum.

3. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E 84.

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

2.4 ACCESSORIES

A. Tape: Sealing tape for wood stud plates to stop moisture migration.

B. Acoustical Mat: USG Levelrock SRM 25, sound reduction mat.

C. Slab Isolation Joints: 1/2-inch thick polyurethane foam.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions of surfaces over which underlayment is to be installed. Verify proper nailing of plywood and have weakened or delaminated areas replaced.

B. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum bi-products.

3.2 PREPARATION

A. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.

B. Vacuum clean surfaces.

C. Close floor openings. Do not install underlayment until floor penetrations and peripheral work are complete.

D. Lay acoustical mat over entire subfloor. Install isolation strips around the perimeter of the room to eliminate flanking sound paths. Tape all seams with manufacturer approved tape.

3.3 APPLICATION

A. Install underlayment in accordance with manufacturer's instructions.

B. Mixing Proportions: Mix proportions and methods shall be in strict accordance with product manufacturer recommendations.

C. Gypsum cement shall be poured prior to partition installations so as to be continuous beneath partitions.

D. Gypsum concrete shall be applied to a minimum thickness of 1-1/2-inches. Spread and screed to a smooth surface, placing as continuous as possible until pour is complete so that concrete is not placed against concrete that has obtained initial set, except at authorized joints.

3.4 CURING

A. After gypsum concrete has set, provide for continuous approved ambient temperature and adequate ventilation to remove excess moisture from the area until the underlayment is dry. Check for dryness by placing a 24-inch by 24-inch section of polyethylene sheet over the underlayment with edges taped. Gypsum concrete is considered dry when condensation does not occur under plastic overnight.

B. Protection from Heavy Loads: During construction, place temporary wood planking over gypsum cement underlayment wherever it will be subject to heavy wheeled or concentrated loads.

3.5 PREPARATION FOR INSTALLATION OF GLUE DOWN FLOOR GOODS

A. Sealing: Seal all areas that receive glue down floor goods, and all areas within 10 feet of any water source with manufacturer's approved sealer and according to the sealer manufacturer's specifications. Any floor areas where the surface has been damaged shall be cleaned and sealed regardless of floor covering to be used. Where floor goods manufacturers require special adhesive or installation systems, their requirements supersede these recommendations.

3.6 PROTECTION OF FINISHED WORK

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.

3.7 CLEANING

A. Upon completion of work, all excess materials resulting from the application of the underlayment shall be cleared from the job site, leaving it in a clean and acceptable condition.

B. Maintain clean isolation joints free of all bridging elements. Remove debris, gypsum cement, and other materials that bridge isolation joints.

END OF SECTION

GROUTS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the installation of non-metallic non-shrink grout, metallic non-shrink grout/epoxy non-shrink grout, and anchoring cement including, but not limited to, installation of:

1. Grout and anchoring cement for metal fabrications.

2. Grout for steel base plates.

3. Grouting of exterior door frames in CMU walls.

4. Grout for support of plumbing, fire sprinkler, and HVAC equipment.

5. Grout for support of electrical and communications equipment.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Manufacturer’s product information on grout and anchoring cement materials.

C. Laboratory and field test reports for structural grout work. Comply with requirements in Division 1 Section "Quality Control."

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not place grout when temperature or humidity will affect the performance or appearance of the grout.

B. Do not place grout on dirty, wet, or frozen substrates.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metallic and Non-Metallic Non-Shrink Grout and Anchoring Cement:

1. Dayton Superior.

2. The Euclid Chemical Co.

3. Master Builders, Cleveland, OH, 216/831-5500.

4. W.R. Meadows, Elgin, IL, 312/683-4500.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Non-Metallic Non-Shrink Grout:

1. Type: Premixed, packaged, shrink resistant, non-metallic.

2. Industry Standard: ASTM C1107.

3. Minimum Compressive Strength: f′c = 7,000 psi in 28 days.

4. Manufacturers:

a. Dayton Superior "Sure-Grip High Performance Grout."

b. Master Builders "Masterflow 928."

c. W.R. Meadows "Sealtight 588."

d. Euclid “Hi Flow Grout.”

e. Five Star Products “Five Star Fluid 100.”

B. Metallic Non-Shrink Grout/Epoxy Non-Shrink Grout:

1. Type: Premixed, packaged, shrink resistant, metallic.

2. Industry Standard: ASTM C1107.

3. Minimum Compressive Strength: f′c = 6,000 psi in 28 days.

4. Manufacturers:

a. Euclid "Hi-Flow Metallic."

b. Master Builders "Embeco 636 Plus."

C. Anchoring Cement:

1. Type: Premixed, packaged, shrink resistant.

2. Minimum Compressive Strength: f′c = 3,000 psi in 28 days.

3. Manufacturers:

a. Euclid "K-Ment."

b. Master Builders "Embeco 153."

D. Additives containing calcium chloride are not permitted.

PART 3 EXECUTION

3.1 INSTALLATION

A. Grout Below Bearing Plates:

1. Support bearing plates above cleaned bearing surfaces with double-nutted anchor bolts or wedges.

2. Fill space below bearing plates supporting structural members and stationary equipment with non-metallic non-shrink grout.

3. Fill space below bearing plates supporting vibrating equipment with metallic non-shrink grout.If the grout may be exposed to moisture, fill the space below the bearing plates supporting vibrating equipment with non-metallic non-shrink epoxy grout.

B. Grout in Steel Door and Relite Frames: Install non-metallic non-shrink grout between masonry rough opening and door/relite frames in masonry walls, fully filling frames with grout.

C. Anchor Bolts with Anchoring Cement:

1. Set anchor bolts for structural plates with anchor bolts double-nutted to 3/4-inch thick CDX plywood templates.

2. Set anchor bolts for equipment with anchor bolts double-nutted to templates furnished by equipment manufacturer.

3. Fill around anchor bolts with anchoring cement as recommended by anchoring cement manufacturer.

3.2 COMPLETION

A. Grout Testing:

1. When required by building code, Owner will employ an independent testing laboratory to evaluate grout supporting structural members.

2. Comply with building code for evaluation of grout work.

B. Adjusting Defective Work: Replace or patch grout and anchoring cement as directed by Architect.

C. Physical Barrier Protection:

GROUTS

1. Cover fresh grout and anchoring cement for 24 hours minimum.

2. Cover fresh grout and anchoring cement with plywood where exposed to construction traffic.

END OF SECTION

BRICK MASONRY UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, and equipment required for the installation of all brick masonry units. Include sealing and waterproofing masonry walls.

B. Products Furnished But Not Installed Under This Section: Division 4 Section "Concrete Masonry Units," for brick wire ties embedded in mortar joints of concrete masonry units.

C. Products Installed But Not Furnished Under This Section: Division 5 Section "Structural Steel Framing," for galvanized steel lintels.

D. Related Section: Division 7 Section “Water-Resistive Air Barrier Membrane” for weather resistant barrier and membrane flashings.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. Brick Institute of America (BIA), Technical Notes on Brick Construction.

C. Oregon Masonry Guild.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product Data: For each type of product indicated.

1. Masonry units:

   a. Include material test reports substantiating compliance with requirements.

   b. Include size-variation data verifying that actual range of sizes falls within specified tolerances.

   c. For exposed brick, include test report for efflorescence according to ASTM C 67.

2. Cementitious materials. Include brand, type, and name of manufacturer.

3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

4. Grout mixes. Include description of type and proportions of ingredients.

5. Anchors, ties, and metal accessories.

C. Brick samples showing complete range of color and surface texture. Only brick approved in writing shall be used.

D. Mortar color samples.

1.4 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color blend within the ranges accepted for these characteristics, from single source manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Mock-Ups: Build sample face brick wall approximately 4-foot by 6-foot size showing bond, jointing, mortar color, and blending of the color range of units as applicable. Approval required before ordering brick and proceeding with masonry wall work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Palletize masonry units to facilitate handling and storage on site and to protect from damage. Cover stacks at plant with a waterproof protective covering and maintain in place during transportation and storage. Keep brick clean and uncontaminated.

B. Keep bagged materials dry, protected from weather damage and with complete labels and identification on wrappings. Store aggregates in bins or piles on platforms out of mud and water, sheltered from weather. Remove and discard all damaged and contaminated material.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed in Paragraph 2.2, Materials.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Face Brick: Mutual Materials, 3-3/8-inch by 2-5/8-inch by 7-5/8-inch. Conform to ASTM C216, FBX Type SW. Provide brick "solids" where detailed and as required where wide face is exposed, wire cut texture.

1. Color Blend: _____.

B. Mortar: ASTM C270, Type S, 1800 psi.

1. Lime: ASTM C207, Type S hydrated lime.

2. Cement: ASTM C150, Type I, light color.

3. Sand: Masons Sand, ASTM C144.

4. Color: Non-fading mortar color, to match color selected by Architect.

   a. Manufacturers: Davis Colors; L.M. Scofield Co.

C. Embedded Flashing Materials:

1. Sheet-Metal Flashing: Fabricate from the following metal complying with requirements specified in Division 7 Section "Flashing and Sheet Metal" and the following:

   a. Stainless Steel: Type 304, 0.0156-inch thick, ASTM A240.

   b. Fabricate through-wall metal flashing embedded in masonry with ribs formed in dovetail pattern at 3-inch intervals along length of flashing to provide a 3-way integral mortar bond and weep hole drainage.

   c. Fabricate metal expansion-joint strips from sheet metal indicated above, formed to shape indicated.

   d. Application: Use where flashing is fully or partly concealed in masonry wall.

   e. Manufacturers:

      (1) "Flashing (Dovetail)" by Cheney Flashing Co.

      (2) "3-Way Interlocking Thruwall Flashing" by Keystone Flashing Co.

2. Self-Adhering Flexible Flashing:

   a. Manufacturer’s standard composite flashing product consisting of a pliable and highly adhesive rubberized asphalt compound, 32 mils thick, bonded completely and integrally to a high-density, cross-laminated polyethylene film, 8 mils thick, to produce an overall thickness of 40 mils.

   b. Primer: Flashing manufacturer’s standard product or product recommended by flashing manufacturer for bonding flashing sheets to masonry and concrete for optimum adhesion.

   c. Manufacturers:

      (1) "Perm-A-Barrier Wall Flashing" by W.R. Grace & Co.

      (2) “Blueskin TWF” by Henry Company.

(3) "Polyguard 300" by Polyguard Products, Inc.

3. Solder and Sealants for Sheet-Metal Flashings: As specified in Division 7 Section "Flashing and Sheet Metal."

4. Adhesive for Flashings: Of type recommended by manufacturer of flashing material for use indicated.

D. Weep Holes: "WeepVent" manufactured by Mortar Net USA.

E. Weep Hole Drainage System: 10-inches high, 5-feet long, thickness to match wall cavity ±1/4-inch. "The Mortar Net" by Mortar Net USA, Ltd., 800-664-6638.

F. Brick Anchors:

1. Type 304 stainless steel adjustable ties, 3/16-inch diameter wire by the length necessary to anchor in mortar joint a minimum of 2-inches. 1/4-inch diameter wire ties required for cavity space 2-inches or more between back face of brick and structural support.

2. Brick Anchor Accessories: Hohmann & Barnard adjustable wire veneer and back up anchors.

a. Frame Wall: HB-213-2X with X-SEAL Tape.

b. Concrete Masonry Wall: 165 S.I.S. Truss.

c. Seismic Reinforcing: HB Seismiclip Interlock System, and Type 304 stainless steel continuous 3/16-inch diameter wire (W1.7) at each anchor location.

3. Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange by not less than 3 exposed threads and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B117. Elco Industries "Dril-Flex" or Hilti "Kwik-Flex."

G. Masonry Water Seal: Isobutyltrialkoxy silane in denatured ethyl alcohol solvent, minimum 40% active content by volume. Degussa Corp. "Chem-Trete BSM-40 VOC," ChemRex "Hydrozo Clear 40 VOC."

H. Graffiti Protection:

1. Silicone elastomer anti-graffiti coating.

2. Manufacturers: ProSoCo "Defacer Eraser SC-1," American Polymer Corp. "Graffiti Solution System."

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces supporting or joining masonry work, and report unsatisfactory conditions to Architect for decision. Starting work indicates acceptance of surfaces by the Contractor. Do not lay masonry on frozen, frosted or water-saturated surfaces.

B. Weather Resistant Barrier: Except for components of the weather resistant barrier that must be integrated with flashings and brick veneer installation, confirm that other components of the weather resistant barrier system and exterior wall cavity insulation are in place and ready for cover before beginning work.

3.2 INSTALLATION

A. All work shall be performed in an accurate manner by mechanics skilled in laying masonry units. All items laid true and plumb with joints in perfect alignment.

B. Provide approved method to maintain temperature above 40°F in materials and work performed during freezing weather and protect from frost for minimum of 48 hours. Protect uncompleted work and working surfaces from rain, work only under approved shelter when raining, and provide shade and water sprays as required to prevent rapid drying out in hot weather. Weather protection shall be continuous during construction until work is complete and capped.

C. Measure materials accurately for each batch in conformance with approved mix design. Mix for at least five minutes in a mechanical batch mixer. Hand mixing not permitted without specific approval of Architect. Use all mortar and grout within 2-1/2 hours after initial mixing and discard sooner than 2-1/2 hours if set has begun.

D. Lintels: Install hot-dip galvanized structural steel or precast reinforced brick masonry lintels over all openings. Build to details on Drawings. Minimum 4-inches bearing at each end.

E. Flashing: Build-in all flashing required to waterproof wall and to join with adjacent work.

F. Brick Anchors:

1. Provide approved anchors in compliance with IBC and not less than one per each 2 s.f. of wall area and at not over 24-inches o.c. horizontal and 24-inches o.c. vertical spacing. Provide additional ties as required and spaced not over 3-feet apart and within 12-inches of the edge around all openings and at each third course at jambs. Install anchors in second course above and below ledger angles.

2. Ties shall slope down and out not over 10° from horizontal, to divert water to outside, be of proper size for each installation and kept 5/8-inch minimum back of exposed masonry face:

a. At wood framing, anchor ties with No. 10 x 2-inch galvanized screws through sheathing and into solid framing.

b. Brick anchors in concrete unit masonry walls are installed under Division 4 Section "Concrete Masonry Units."

G. Building-In and Setting Other Work: Locate accurately by dimension or template built-in anchors, accessories, and work of other trades where installed in or supported by masonry. Fill hollow metal frames with mortar or grout where built into masonry.

H. Expansion Joints: Lay up 1/2-inch wide continuous vertical joints, plumb and true as detailed. Do not exceed 20-feet o.c. at exterior locations and 20-feet to 30-feet o.c. at interior locations to divide large wall areas. Do not continue horizontal joint reinforcement through expansion joints, nor will saw cutting of expansion joints be permitted. Minimum number of expansion joints shall be as required by the BIA's Technical Notes on Brick Construction, whether or not shown on the Drawings.

I. Masonry Bond and Joints:

1. Pre-wet brick to control rate of suction at time of laying to not exceed 0.025 oz./sq.in.

2. Use standard running bond with all stretcher units unless otherwise detailed or required at cavity walls. Maintain regular modular dimensions horizontally and vertically with coursing as detailed. Cut all face units where required to maintain regular pattern except no units less than half a brick long without approval.

3. Lay units with full head and bed joints and units shoved into place. Fully embed both surfaces of flashing in mortar within joints. Tool and compact exposed face joints to give concave rodded finish. Provide weep holes in each third vertical joint along bottom course just above any sill or head flashing.

4. Weep Hole Wall Drainage System:

a. Lay the first one or two courses of brick at flashing level, then install weep hole drainage system continuously by placing it against the inside of the outer wythe, dovetail shaped section of the material facing up, directly on the flashing at the base of the wall and over all wall openings. No fasteners or adhesives are required, and mortar need not have set. Weeps shall be open vertical joints on lowest brick course, every third joint, filled with weep hole drainage system.

b. Weep hole wall drainage system may be cut to accommodate wall ties, conduit, plumbing, or other materials that bridge or intrude into the cavity between the inner and outer walls.

c. When forcing weep hole drainage system into a cavity, compressing it not more than 1/4-inch, be sure mortar has set sufficiently to resist the outward pressure.

5. Stop-off horizontal runs of masonry by racking back half a unit length in each course or in accordance with special pattern bonds. Re-lay units in fresh mortar that are moved or shifted after mortar has stiffened.

6. Remove mortar stains with clean water as work progresses. Protect all sills, ledges, offsets, and other projections from mortar and grout droppings.

7. Upon completion of work, clean all exposed surfaces using methods and procedures as recommended by the Structural Clay Products Institute, the Oregon Masonry Guild, and the brick manufacturer.

J. Protection and Curing: Furnish temporary protection for all exposed masonry corners subject to injury. Protect masonry against too rapid drying by fogging or sprinkling thoroughly and often enough to properly cure the work.

K. Protecting Adjacent Work and Surfaces: Cover or mask with strong protective covering. Clean up spilled mortar and materials as required to prevent tracking into and damage to other areas. Repair damage to adjacent surfaces caused by masonry work.

3.3 MASONRY SEALING

A. General:

1. All work shall be performed by workers skilled and experienced in the application of this coating material.

2. Sealer to be applied in strict adherence to manufacturer's instructions.

3. All material shall be delivered to the job site in original containers with labels and seals unbroken.

4. Protect all adjacent surfaces from damage and contamination.

B. Restrictions:

1. Do not apply on surfaces which have been wet or rained on during four preceding days or if rain is anticipated within twelve hours after application.

2. Do not apply sealer to frost filled surfaces or when the temperature falls below 40°F.

3. Do not apply sealer to non-absorbent materials such as glass, metal, glazed brick, or glazed tile.

4. Do not apply sealer to areas that receive graffiti protection.

C. Cleaning and Testing:

1. Clean masonry additionally to remove all traces of dirt, mortar stains, and efflorescence. Use only cleaners recommended by sealer manufacturer. Do not use caustic or alkaline type cleaners.

2. Test masonry for proper dryness as recommended by sealer manufacturer, and defer application of sealer until conditions are acceptable.

D. Application: Apply a light fogging spray to thoroughly wet the wall to break the surface tension. Follow immediately with the flood coat to achieve the deep penetration required for water

repellency. Apply the flood coat with uniform, overlapping, horizontal strokes, and sufficient material saturation to cause an 8-inch to 10-inch rundown from the point of contact. Fully saturate all mortar joints.

3.4 GRAFFITI PROTECTION

A. Application: Before applying, read “Preparation” and “Safety Information” sections in the Manufacturer’s Product Data Sheet for Sacrificial Coating SC-1. Do not dilute or alter.

1. Spray surface lightly from top to bottom. Use an overlapping horizontal spray pattern. (Follow up with a vertical stroke for deep vertical recesses). Avoid flooding the surface or creating heavy rundowns.

2. Let treatment penetrate for one to two minutes. Remove buildups using a damp brush or roller.

3. Let previous coat dry to touch (20 to 30 minutes). Lightly apply subsequent coats. Will dry thoroughly in one to two hours.

4. After the surface is dry, inspect for a continuous light film across the surface. Three or four coats may be required for protection of more porous surfaces.

B. Limitations:

1. Abrasion will damage coating.

2. Graffiti resistance may be reduced by maintenance cleaning. Reapply sacrificial coating to restore graffiti resistance.

3. Not suitable for application over existing water repellents.

4. Not suitable for horizontal surfaces.

5. May blush on certain substrates.

3.5 CLEANING

A. Remove waste and excess material from site. Do not dump excess mortar and wash from mixer on the site. Leave grounds, pavements, and building areas clean.

END OF SECTION

CONCRETE MASONRY UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish labor, material and equipment for the installation of concrete masonry units.

B. Products Installed But Not Furnished Under This Section: Division 4 Section "Brick Masonry Units" for brick wire ties imbedded in concrete unit masonry.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. Building Code Requirements and Specifications for Masonry Structures (ACI 530-11 and ACI 530.1-11).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop Drawings:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes. Refer to General Structural Notes for block compressive strength.

2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.

3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification:

1. Two split face CMUs, in the form of full size units.

2. Accessories embedded in masonry.

D. **List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.**

1. **Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.**

E. Qualification Data: For testing agency.

F. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.

b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.

3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

4. Grout mixes. Include description of type and proportions of ingredients.

5. Reinforcing bars.

6. Joint reinforcement.

7. Anchors, ties, and metal accessories.

G. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.

2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

H. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

I. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.4 QUALITY ASSURANCE

A. Qualifications: Work performed by workers skilled in laying masonry units, items laid true and plumb, with joints in alignment.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Palletize masonry units to facilitate handling and storage on the site and to protect from breakage or other damage. Store off the ground, protected from dirt and cover to protect from weather damage.

B. Keep bagged materials dry, protected from weather damage and with complete labels and identification on wrappings, store aggregates in bins or piles or platforms out of mud and water, sheltered from weather. Remove and discard all damaged and contaminated material.

C. Do not bend or deform reinforcing during handling and storage. Maintain clean and free of rust and contamination detrimental to bond.

1.6 PROJECT CONDITIONS

A. Inspect all surfaces supporting or joining masonry work and report unsatisfactory conditions to Architect. Starting work indicates acceptance of surfaces. Do not lay masonry on frozen, frosted, or water saturated surfaces.

B. Provide approved method to maintain temperature above 40°F in materials and work performed during freezing weather and protect from frost for minimum of 48 hours. Protect uncompleted work and working surfaces from rain with waterproof covering.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed in Paragraph 2.2, Materials.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Concrete Block:

1. Hollow load bearing concrete block, double-end type with flush ends, medium weight (105 lbs. to 125 lbs. per cubic foot density) sand and pumice aggregate conforming to ASTM C331 and C33. Concrete block units shall be ASTM C90, Type I, minimum 28-day compressive strength as noted in General structural Notes. Maximum linear shrinkage of 0.065% and 35% moisture content per Table 1, ASTM C90.

2. Furnish all non-standard custom manufactured end, corner, lintel, bond beam, coping, sill and other units required to complete the work. Sizes as detailed and in standard modular dimensions for laying with 3/8-inch joints. Do all cutting of units with masonry saw.

B. Mortar: ASTM C270, Cement-Lime, Type M or S, 1800 psi at 28 days, minimum density 100 lbs./cu. ft.

1. Lime: ASTM C207, Type S hydrated lime.

2. Cement: ASTM C150, Type I.

3. Sand: ASTM C144.

4. Mortar Color: Natural gray.

C. Fine and Coarse Grout: Conform to ASTM C476 and ASTM C1019, 2000 psi, minimum density 100 lbs./cu. ft., 28 day strength. Use only low alkali portland cement.

D. Concrete Block Reinforcing: Deformed steel bars Grade 60, ASTM A615. Ferrous metal shall be hot-dip galvanized where subject to rusting or when within 1/8-inch of an exposed masonry face.

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces supporting or joining masonry work, and report unsatisfactory conditions to Architect for decision. Starting work indicates acceptance of surfaces by the Contractor. Do not lay masonry on frozen, frosted or water-saturated surfaces.

3.2 INSTALLATION

A. Building In and Setting Other Work: Built in anchors, accessories, and work of other trades where installed in or supported by masonry, locating accurately by dimension or template. Fill hollow metal frames with grout where built into masonry.

B. Provide approved method to maintain temperature above 40°F in materials and work performed during freezing weather and protect from frost for minimum of 48 hours. Protect uncompleted work and working surfaces from rain, work only under approved shelter when raining, and provide shade and water sprays as required to prevent rapid drying out in hot weather. Weather protection shall be continuous during construction until work is complete and capped.

C. Concrete block shall be dry at time of laying. Lay block with full face shell bed and end mortar joints. Press units into place and avoid shifting or tapping units to adjust after laying. Remove and relay units with fresh mortar when moved after mortar has started to harden. Reinforce walls horizontally and vertically as detailed. Provide ties and otherwise conform to the IBC. Grout all door frames and fill all cores.

D. Finish joints with a concave edge steel jointer tool, impacting the mortar to a dense smooth surface. Strike joints flush where wall surface is to receive a weather resistant barrier.

E. Use a standard running bond with all stretcher units unless otherwise detailed. Maintain regular modular dimensions horizontally and vertically with 3/8-inch mortar joints. Make all cuts in exposed finish work with masonry saw. Locate electrical device boxes in cutout corners of one unit as approved. Stop off work by racking back.

F. Build forms to make finished work conform to dimensions and shapes as detailed. Make forms tight to prevent loss of mortar or grout and shore for temporary support until cured and structurally sound.

G. Repair or replace units and point joints wherever damaged or defective. No broken units permitted.

H. Furnish temporary protection for all exposed masonry corners subject to injury. Cover and keep masonry wet by fogging or sprinkling thoroughly and often enough to properly cure the work.

~~I.~~ Keep mortar cleaned off masonry surfaces as work progresses. Brush mortar from faces of units before it has set.

J. All reinforced hollow unit masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Walls and cross webs forming such cells to be filled shall be full bedded in mortar to prevent leakage of grout. Vertical cells shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than 2-inches x 3-inches.

K. Provide cleanout openings at the bottom of all cells to be filled at each pour of grout where such grout pour is in excess of 5-feet 4-inches in height. Any overhanging mortar or other obstruction or debris shall be removed from the insides of such cell walls. After inspection, the cleanouts shall be sealed before grouting.

L. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 48-inches.

M. All cells shall be filled solidly with grout. Grout shall be poured in lifts of 4-feet maximum height and special inspection during grouting shall be required. All grout shall be consolidated at time of pouring by puddling or vibrating and then reconsolidated by again puddling later, before plasticity is lost.

N. When the grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout not less than 1/2-inch below the top of the uppermost unit grouted. Horizontal steel shall be fully embedded by grout in an uninterrupted pour.

O. Brick Veneer Anchors in Concrete Masonry Unit Substrate: Install approved anchors in compliance with IBC and not less than one per each 2 s.f. of wall area and at not over 32-inches o.c. horizontal and 18-inches o.c. vertical spacing. Provide additional ties as required and spaced not over 3 feet apart and within 12-inches of the edge around all openings and at each third course at jambs. Install anchors in second course above and below ledger angles.

3.3 CLEANING

~~A.~~ Remove excess mortar.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. An independent testing laboratory will be employed and paid for by the Owner to conduct special inspection and testing of masonry work as required in compliance with the IBC. Cooperate with the independent testing laboratory in taking of tests and conducting inspection services.

2. Masonry strength shall be verified by using the unit strength method. Perform compression tests for each set of mortar and grout test cylinders.

3. Written reports of all tests and inspections will be submitted by the independent testing laboratory to the Architect, Contractor, masonry unit producer, and other offices as directed by the Architect.

3.5 PROTECTION OF FINISHED WORK

A. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

3.6 CLEANING

A. Remove waste and excess material from site. Do not dump excess mortar and wash from mixer on the site. Leave grounds, pavements, and building areas clean.

END OF SECTION

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SUMMARY

A. The General Structural Notes shall be used in conjunction with these specifications. The General Structural Notes shall supersede items in this specification when discrepancies exist.

B. Provide structural steel members, including all anchor bolts and other devices required for installation.

A. Shop fabricate miscellaneous steel and iron work, including brackets, braces, angles, lintels, anchors, supports, or other items shown on Drawings for support or connection of other work. Shoring or other temporary braces required for stabilization of the wall during construction will be provided by the Contractor.

B. Furnish items to other trades when setting and installation is part of their work.

C. A list of items needed for the construction of the building are herein specified and constitutes a description of the type of materials necessary to fabricate such items. However, this does not imply that each individual item on the job is herein listed.

1.2 REFERENCES

A. The American Institute of Steel Construction (AISC).

1. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.; 2011.

2. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2010.

3. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts; 2004.

B. American Society for Testing and Materials (ASTM).

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

2. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished; 2007.

3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

4. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength; 2010.

5. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2010.

6. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2010a.

7. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011.

8. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2011.

9. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners; 2009.

10. ASTM A53 / A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

11. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

12. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.

C. The American Welding Society (AWS).

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.

2. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.

D. The Society for Protective Coatings (SSPC).

1. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings detailing fabrication of structural steel components.

1. Cross reference shop drawing details to detail numbers on the Drawings to facilitate checking.

2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.

C. Steel erection plan as required for stability during construction of the steel frame and prepared by a registered professional engineer in the State of Oregon.

D. Provide AWS cerificate copy for all welders. Submit to Architect prior to fabrication.

E. Welding procedure specifications (WPS) for all different welding types and fit-ups.

F. Provide mill certificates attesting to grades of structural steel, steel tubing and pipe.

G. Submit headed studs certification for Nelson process.

H. Qualification Data: For firms and persons specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. All fabrication shall be performed by a Fabricator certified by the American Institute of Steel construction, AISC, Category STD, Standard for Steel Building Structures. The Fabricator shall be certified category STD at the time of bid and shall maintain this certification for the duration of the project.

B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Sbd.

C. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.

D. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store material at the project site above the ground on platforms, skids or other supports, and protect from corrosion. Store nuts, bolts, washers, grout, welding rods and other materials in weathertight and dry location. Keep packaged materials in original, unbroken containers.

B. Structural steel at job site without inspection certificate or erection marks will be rejected.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed in Paragraph 2.2, Materials.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Structural Steel Shapes: ASTM A36, or ASTM A572 Grade 50 where indicated, standard rolled sections of size and weight fabricated as detailed.

1. W and WT Shapes: ASTM A992, Grade 50.

2. Other Rolled Shapes: ASTM A36.

B. Cold-Formed Structural Steel Tubing: ASTM A500, Grade B, structural steel tubing in size, weight, and wall thickness fabricated as detailed.

C. Steel Pipe: ASTM A53, Type E or S, Grade B, or ASTM A501, structural steel pipe in size, weight, and wall thickness fabricated as detailed.

D. Ledgers, Angle Frames, Headers, Blocking, and Elevator Sill Angles: ASTM A36, standard rolled section of size and weight fabricated as detailed.

E. **Supports for Brick Ledgers: Fero Corp. 780-455-5098 "FAST" (Fero Angle Support Technology) brackets, sized for 2-inch thick exterior rigid insulation.**

F. Plates, Clips, Hangers and Brackets: ASTM A36, or ASTM A572 Grade 50 where indicated, standard rolled shapes and sections fabricated to sizes and dimensions as detailed.

G. Anchor Rods, Bolts, Screws, Nuts and Washers:

1. Unheaded Rods: ASTM A36

2. Unheaded Rods: ASTM A572, Grade 50

3. Headed Rods: ASTM F1554, Grade 36 and Grade 55, as noted.

4. Headed Bolts: ASTM A307, Grade A; carbon-steel, hex-head bolts; and carbon-steel nuts.

5. Headed Bolts: ASTM A325, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.

6. Headed Bolts: ASTM A490, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.

7. Bolts: ASTM A325X or A490X bolts for structural bolting and ASTM A307 bolts where noted as machine and anchor bolts.

8. Screws: ASTM C954, No. 10 diameter by length required to penetrate steel flange by not less than 3 exposed threads and with polymer coating.

9. Nuts and Washers: Nuts and washers for all bolted connections. ASTM A36.

10. Finish: Hot-dip galvanized finish ASTM A153 Class C when installed with galvanized items.

H. Non-High-Strength Bolts, Nuts and Washers: ASTM A307, Grade A; carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated.

2. Finish: Hot-dip zinc-coating, ASTM A153, Class C.

3. Finish: Mechanically deposited zinc-coating, ASTM B695, Class50

I. High-Strength Bolts, Nuts and Washers: ASTM A325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain, uncoated.

2. Finish: Hot-dip zinc-coating, ASTM A153, Class C.

J. Welding Electrodes: Comply with AWS requirements.

K. Expansion Anchors:

1. Description: Zinc plate finish at interior exposure, stainless steel at exterior exposure.

2. Manufacturers: "Kwik Bolt TZ" by Hilti, "Ramset/Redhead TruBolt" by ITW, “Strong-Bolt 2” by Simpson Strong Tie.

L. Threaded Concrete Anchors:

1. Description: Zinc plate finish, interior use only.

2. Manufacturers: "Titan HD" by Simpson Strong-Tie, Inc., “Kwik HUS-EZ” by Hilti.

M. Epoxy Concrete Anchors:

1. Description: Zinc plate finish at interior exposure, hot dipped galvanized at exterior exposure.

2. Manufacturers: "ET" or "SET" by Simpson Strong-Tie, Inc.; “HIT-HY 200” or HIT-RE 500” by Hilti.

A. Galvanizing Repair Compound: ZRC Worldwide “Galvilite,” 95% zinc in dry film using Type III ultra-pure ASTM D520 zinc (lead and cadmium free.) Exceeds Fed. Spec DOD-P-21035A.

2.3 FINISHES

A. Hot-dip galvanized finish ASTM A123, Coating Grade 60, for all steel and iron items exposed in exterior locations, and elsewhere as detailed. One shop coat rust inhibiting primer paint on all

other items whether concealed or exposed, except do not prime surfaces to be bonded into concrete or masonry, at friction-type bolted connections, or surfaces within 2-inches of bolts or welds.

2.4 FABRICATION

A. Incorporate minimum reference standard for fabrication and erection; AISC Specifications and AISC "Steel Construction Manual."

B. Cut shapes to pattern, sizes, and dimensions as detailed and approved. Punch and drill holes accurately, maintaining proper edge and end clearance and proper diameter to fit each fastening. Countersink holes for flat head wood screws.

C. Camber structural steel members where indicated.

D. Remove rust, scale, grease and oil after fabrication and prime paint.

E. Furnish and shop assemble all items true to measurements taken at the job, disassembled and ship to the job, complete with all sleeves, bolts, etc., necessary for erection.

F. Mark each member or assembly of members with erection marks for identification; furnish an erection diagram with marks shown. Load structural members or assembled units in such a manner that they may be transported and unloaded without being excessively stressed, deformed or otherwise damaged. Place fabricated material on skids, off the ground; keep clean and properly drained.

G. All welding performed by AWS certified welders and in accordance with AWS Code. Grind welds on architecturally exposed items to make smooth and flush when ready for paint finish.

H. Grind smooth all welds as required for proper fit up and connection of other members.

I. Grind exposed ends and cut edge of all items smooth and slightly beveled to remove sharpness, burrs, and cutting marks. Use gas cutting torch in the field to cut holes or correct fabrication errors only after submitting each condition to Architect for review.

PART 3 EXECUTION

3.1 ERECTION

A. Comply with the AISC "Code of Standard Practice for Steel Buildings and Bridges."

B. Use special care in unloading, handling, and erection, to avoid bending, twisting, or otherwise distorting the members. Plan and execute the erection in such a way that the close fit of the joints and the structure as a whole will not be impaired.

C. 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.

D. Do not field cut or alter structural members without approval of Architect.

E. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

F. All visible bolts within an interior or exterior space shall be facing the same direction.

G. Remove all construction support and unrelated added components not necessary for the structural performance of the steel element.

H. Do not set permanent bolting or welding until as much of the structure as will be stiffened thereby has been properly aligned within tolerances.

I. At completion of erection, touch-up paint bolts and field welds and abrasions with the same paint used for shop painting. Repair galvanized steel in accordance with ASTM A780.

3.2 FIELD ASSEMBLY

A. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

B. Level and plumb individual members of the structure within AISC tolerances.

C. All beams and girders shall be cambered as indicated on the Drawings. Where no camber is specified, natural camber of the member shall be up, opposite for cantilevers.

D. Splice members only as detailed or specified.

E. Provide temporary bracing where necessary to take care of loads to which the structure may be subjected, including erection equipment, and its operation. Leave bracing in place as long as may be required.

F. It is the Contractor’s responsibility to employ the use of a steel erection plan as required for stability during construction of the steel frame. An erection plan shall be prepared by a registered professional engineer in the state of Oregon.

G. Bolt using high-strength threaded fasteners. Assemble in accordance with AISC Specification for Structural Joints, using ASTM A325 or ASTM A490 bolts; 2004.

H. Provide angle frame headers and blocking (or other standard shapes if detailed otherwise) at steel deck penetrations, sized for span and dead/live loading to match adjacent deck loading design.

I. **Install brick ledger angles as detailed using brick ledger angle supports, sized, spaced, and anchored in accordance with angle support manufacturer’s printed instructions.**

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections: The Owner will employ the services of an independent testing laboratory for performing tests and to conduct inspection services on all shop fabricated and on-site structural welding and bolting plus expansion anchor, grouted anchor, and adhesive anchor placement in hardened concrete required for this construction and as required per the Statement of Special Inspections within the Structural Drawings.

END OF SECTION

METAL DECKING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material and equipment required for the installation of the metal decking in type and location detailed.

B. The General Structural Notes shall be used in conjunction with this specification. The General Structural Notes shall supersede items in this specification when discrepancies exist.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM) A36, Standard Specification for Carbon Structural Steel.

B. ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

C. ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. International Building Code (IBC).

E. Steel Deck Institute (SDI), Publication No. 31, Design Manual for Composite Decks, Form Decks, Roof Decks.

F. American Iron and Steel Institute (AISI).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings: Indicate deck plan, support locations, projections, openings, reinforcement, accessories, and installation details.

C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.4 QUALITY ASSURANCE

A. AISI Specifications: Calculate structural characteristics of steel deck according to AISI’s "Specification for the Design of Cold-Formed Steel Structural Members."

B. Provide manufacturer's certificate of compliance with design requirements. Comply with SDI Specifications and Commentary, Publication No. 29.

C. Conform to the applicable portions of International Building Code, and requirements of the Standard Floor Deck Specifications published by SDI. Conform to ASTM A-446.

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

E. Welder Qualifications: Quality procedures and personnel according to AWS D1.3.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Decking Manufacturers:

1. ASC Steel Deck.

2. Verco Manufacturing.

B. Other Products: Manufacturers are listed in Paragraph 2.2.

C. Other Manufacturers: Submit Substitution Request prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Roof Metal Decking:

1. Decking and accessories shall be formed from steel sheets conforming to ASTM A653 with ASTM A653 light commercial galvanized coating.

2. Provide section, depth, and gauge of type as detailed. Provide rib closures of same gauge as deck to block spaces at walls, and other miscellaneous accessories and hardware items necessary to complete the installation.

B. Fasteners: Hilti, Self-tapping, Self-drilling, case hardened carbon steel with electroplated zinc coating complying with ASTM F1941, or approved equal.

C. Roof Drain Pans: Formed from steel sheets conforming to ASTM A611 of 14 gauge sheet steel, and coated per ASTM A653 G185galvanized coating.

D. Accessories: Flexible closure strips, pour stops, girder fillers, column closures, end closures, Z-closures, and cover plates shall be a minimum of 18 gauge sheet steel except where a greater gauge is required by the deck manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Place decking on supporting framework and adjust to final position before being permanently fastened. Welding performed by certified welders.

B. Fasten deck to support members as specified on structural drawings.

C. Verify location of penetrations, and accurately cut openings. Openings required by other trades and not shown on the Drawings are the responsibility of the trade requiring the openings. Cutting and reinforcement must be approved, see structural drawings. Reinforcement at openings shall be sufficient to prevent deflection in excess of that for un-penetrated deck.

D. Fasten side laps between adjacent sheets as detailed on structural drawings. Side laps shall be fastened with screws, hydraulic crimping/punch or welds. Side lap fasting shall be spaced at 24 inched on center, unless otherwise shown on drawings.

E. Top surfaces flat and in plane so that a 4-foot straightedge placed across the ribs over a supporting joist or beam shall touch surfaces and top flanges shall not be concave.

F. Fit decking around columns, support angles, and openings shown on the Drawings. Fasten units with flutes in accurate and straight alignment. Place all panel ends over structural supports. Provide a minimum of two inches of positive bearing over full width of panel and without deformation of units.

G. Provide decking supports at columns and elsewhere as required though not shown.

H. Where deck changes direction, install 6” minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.

I. Place metal cant strips in position and fusion weld.

J. Position roof drain pans with flange bearing on top of surface of deck. Fusion weld at each deck flute.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections: The Owner will employ the services of an independent testing laboratory for performing tests and to conduct inspection services on all on-site steel deck welding required for this construction and as indicated in the Statement of Special Inspections within the Structural Drawings.

END OF SECTION

METAL SUPPORT FOR CLADDING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, and equipment required for the installation of metal support systems for attachment of exterior cladding to building structure:

1. Fiber reinforced hybrid siding.

B. Related Sections:

1. Division 6 Section “Rough Carpentry,” coordinating alignment with framing.

2. Division 7 Section “Thermal Insulation,” for insulation installed within metal support systems.

3. Division 7 Section “Fiber Reinforced Hybrid Siding.”

1.2 REFERENCES

A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2007.

B. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.

C. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2006a.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the alignment of Rough Carpentry with size, location and installation of metal supports for cladding.

1.4 DESIGN REQUIREMENTS

A. Components: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall as calculated in accordance with IBC.

1. All components shall be designed and constructed to resist wind loads as specified in Chapter 6 of ASCE 7-10, and as specified in the 2012 IBC.

B. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing without buckling, distortion, joint failure, or undue stress on system components, anchors, or permanent deformation of any kind.

C. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within cladding support system.

D. Products: Provide continuity of thermal barrier at building enclosure elements.

1.5 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop Drawings: Complete shop drawings shall be submitted for approval prior to fabrication, including elevations, and sections of each condition. Such drawings shall also include metal thickness, finish, methods of installation, anchorage and expansion joints, width, bow, camber and squareness tolerances necessary to accommodate thermal movement.

C. Bidder Designed Members and Attachment: Bidder shall supply structural engineering analysis for design of the required metal support system and its connection to metal stud wall backing.

D. Samples: Submit 3 sets of the following samples in the selected finishes for Architect approval.

1. 12 inch long by full profile sample of each attachment component.

2. 12 inch long by full profile sample of each type sheet metal trim and closure pieces.

E. Evaluation Service Reports: Show compliance with specified requirements.

F. Installer's Qualification Statement.

G. Certificates: Certify that products of this section meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Field Measurements: Prior to fabrication of exterior wall system, take field measurements of structure and substrates to receive wall system.

B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

2.1 FABRICATED COMPONENTS

A. CLADDING SUPPORT SYS, Material: Minimum 16 gauge galvanized steel sheet, ASTM A653 G90 coating.

1. MTL CLIP: Horizontal clips.

2. MTL ANGLE: Horizontal angles.

3. MTL SUBGIRT.

4. SHT MTL ANGLE: Horizontal sheet metal angles.

2.2 ACCESSORIES

A. Fasteners: Stainless Steel.

B. Foam Sealant Tape:

1. Tremco Illbruck Ltd., “TP 445 Compriband VSA 2.”

2. Emseal Joint Systems, Ltd., “Backerseal (Greyflex).”

C. Bituminous Paint: Cold-applied mastic, SSPC Paint 12, compounded for 30 mil thickness per coat. All metal surfaces that are detailed to be in contact with fire-retardant or preservative pressure treated wood shall receive one coat of bituminous paint.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that building framing members are ready to receive metal supports for cladding.

3.2 INSTALLATION

A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at intervals indicated.

1. All fasteners shall be attached to substructure.

2. Spacing of Fasteners: Per deferred submittal design.

B. Secondary Structural Supports: Install girts, angles, and other secondary structural panel support members and anchorage according to the Light Gage Structural Institute's "Guide Specifications," Section 07410, "Manufactured Roof and Wall Panels."

C. Install anchor channels and clips as indicated and in accordance with manufacturer’s instructions.

D. Install sufficient anchorage devices to securely and rigidly fasten system to building.

E. Provide anchors to be installed in other work, and setting details, in time for proper installation by trades concerned; verify correct placement.

F. Ensure assembly is plumb, level and free of warp or twist; maintain dimensional tolerances and alignment with adjacent work.

G. Built-In Work:

1. As work progresses, build in anchor bolts, flashing and other items supplied by other trades.

2. Install items plumb and true.

3. Do not build in organic materials subject to rot or deterioration.

4. Remove protective film from finished aluminum surfaces.

H. Install Foam Sealant Tape at all connections between attachment clips and vertical runners per manufacturers written instructions

I. Install in accordance with manufacturer's instructions.

3.3 ERECTION TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16-inch.

B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4-inch.

C. Tolerance: Accurately align and locate components to column lines and floor levels; adjust work to conform to following tolerances.

1. Plumb: 1/8" in 10' -0"; 1/4" in 40' -0"; non-cumulative.

2. Level: 1/8" in 20' -0"; 1/4" in 40' -0"; non-cumulative.

3. Alignment: limit offset to 1/6" where surfaces are flush or less than 1/2" out of flush, and separated by less than 2" (by reveal or protruding work); otherwise limit offsets to 1/8".

4. Location: 3/8" maximum deviation from measured theoretical location (any member, and location).

END OF SECTION

METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Examine Drawings for required items and furnish in sizes, number, and kind to complete the Work.

B. Shop fabricate miscellaneous steel, including brackets, railings, angles, anchors, supports, and other items as detailed for support or connection of other Work.

C. Furnish items to other trades when setting and installation is part of their Work.

1.2 REFERENCES

A. American Institute of Steel Construction (AISC).

B. American Society for Testing and Materials (ASTM).

C. The Society for Protective Coatings (SSPC).

D. National Association of Corrosion Engineers International (NACE International).

E. International Code Council (ICC).

F. Occupational Safety and Health Administration (OSHA).

G. International Building Code (IBC).

H. American Welding Society (AWS).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section “Submittal Procedures.”

B. Shop drawings showing dimensioned details of all components. Cross-reference shop drawing details to detail numbers on the Drawings to facilitate checking.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Qualification Data: For firms and persons specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. For all bidder design Contractor delegated designs noted within the Drawings, provide a design with drawings and calculations stamped by a registered engineer in the State of Oregon.

1.4 QUALITY ASSURANCE

A. Handrails, guardrails, and ladders shall conform to OSHA standards and IBC requirements.

B. Ladders shall conform to OSHA standards, IBC requirements, and ASME/ANSI A17.1 Safety Code for Elevators and Escalators. **(elevator pit ladder in UO elevator spec)**

C. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code – Steel."

2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS

A. Field Measurements:

1. Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

2. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed in Paragraph 2.2, Materials.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. The following is a list of items needed for the construction of the building as specified and constitutes a description of the type of materials necessary to fabricate such items. However, it does not preclude that each individual item on the job is herein listed. It is the responsibility of this Section to completely furnish all items as detailed.

1. Flat Bar: ASTM A36, standard rolled section of size and weight fabricated as detailed.

2. Steel Tubing: ASTM A500, Grade B, structural steel tubing in size, weight, and wall thickness fabricated as detailed.

3. Stainless Steel:

   a. Tubing: ASTM A554, Grade MT-304.

   b. Piping: ASTM A312A, Grade TP-304.

   c. Bar Stock: ASTM A276, Type 304.

4. Plates, Clips, Hangers, Lintels, and Brackets: ASTM A36, standard rolled shapes and sections fabricated to sizes and dimensions as detailed.

5. Screws, Nuts and Washers:

   a. Screws: Furnish wood and lag screws as detailed.

   b. Bolts, Nuts and Washers: Steel bolts complying with ASTM A 307, Grade A, with ASTM A 563 hex nuts and flat washers.

   c. Washers, Where Required: Under head and nut in all wood connections.

   d. Finish: Furnish hot-dip galvanized finish when installed with galvanized items.

6. Expansion Anchors for fastening to concrete:

   a. ICC approved, zinc plate finish.

   b. Manufacturers: “Kwik Bolt TZ” by Hilti and “Strong Bolt II” by Simpson Strong Tie.

7. Steel Ladders and Stairs: Fabricate from standard shapes and size as detailed. All welds ground smooth and flush. Furnish complete with all fittings, brackets, sleeves and hardware required for installation.

8. Handrails: 1-1/2-inches o.d., ERW or DOM round mechanical tubing, 0.156-inch wall thickness, for general areas fabricated as detailed. Stainless steel handrails to be 1-1/2-inch o.d. seamless stainless tubing, ASTM A554, 0.120-inch wall thickness, Type 304, and finished with No. 4 satin. Other sizes as noted. All connections penetration welded using back-up sleeve welding connectors, include end returns to wall and closure plates on open ends. All welds ground smooth and flush. Furnish complete with all fittings, brackets, sleeves and hardware required for installation.

9. Grating:

   a. Elevator Pit Sump: McNichols “GW75 smooth,” main bars 3/4 inch x 3/16 inch, cross bars 5/16 inch hex. Provide end binding bars welded to each end of grate sections. Hot dip galvanize for exterior use.

10. Prefabricated Steel Ship Ladder: L.K. Goodwin Co., 800-343-2478, Model FTHASL30146, height 144-inches, 30-inches clear between handrails, 68 degree incline, bar grating treads, 1-1/2-inch x 14 gauge welded handrails, 10-inch structural channel stringers, gray enamel finish. Field verify height.

11. Aluminum Fixed Vertical Ladder:

    a. Aluminum Fixed Vertical Ladder and Components: Ladder, cage, wall mounting brackets, walk-thru, and side rails.

        (1) Model: Model FL-5 fixed ladder with walk-through, bracket mounted (vertical height in inches varies, field verify each ladder position) Aluminum Fixed Vertical Ladder as manufactured by Precision Ladders LLC.

        (2) Capacity: Unit shall support a 1500 lb (680 kg) loading without failure, and individual treads shall withstand a 3,000 lb (1361 kg) loading without failure.

        (3) Performance Standard: Units designed and manufactured to meet or exceed ANSI A14.3 and OSHA 1910.27.

    b. Components:

        (1) Ladder Stringer: 2-1/2 inch by 1-1/16 inch by 1/8 inch (64 mm by 27 mm by 3 mm) extruded 6005-T5 aluminum channel. Pitch: 90 degrees.

        (2) Ladder Tread: 2-1/4 inch by 3/4 inch by 1/4 inch (57 mm by 19 mm by 6 mm) extruded 6005-T5 aluminum with deeply serrated top surface.

        (3) Ladder Mounting Bracket: 8-1/2 inch by 2 inch by 3 inch by 1/4 inch thick (216 mm by 51 mm by 76 mm by 6 mm) aluminum angle.

        (4) Walk-Thru:

            (a) Hand Rails: 1-1/4 inch (32 mm) aluminum square tube with rounded edges.

            (b) Mounting Brackets: 4 inch by 4 inch by 1/4 inch (102 mm by 102 mm by 6 mm) aluminum.

            (c) Side Rails: 42 inch (1067 mm) side rail extension for through ladder exits.

        (5) **Safety Cage: Vertical and horizontal bars: 1/4 inch by 2 inch (6 mm by 51 mm) 6005-T5 aluminum flat bar.**

        (6) Finishes: Mill finish on aluminum ladder components.

12. Cold Galvanizing Repair Compound: ZRC Worldwide “Galvilite,” silvery-finish, 95% zinc in dry film using Type III ultra-pure ASTM D520 zinc (lead and cadmium free). Exceeds Fed. Spec DOD-P-21035A.

2.3 FABRICATION

A. Examine Drawings for required items and furnish in sizes, number and kind to complete the Work.

B. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

C. Form metal work to required shapes and sizes, with true curves, lines and angles. Provide components in sizes and profiles indicated, but not less than required to comply with requirements indicated for structural performance or, if not indicated, to comply with requirements of authorities having jurisdiction and with structural properties to sustain safety or withstand loads to which normally subjected.

D. Allow for thermal movement resulting from a maximum change (range) in ambient temperature of 100°F, in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and night time sky heat loss. Provide necessary rebates, lugs, and brackets for assembly of units. For Work exposed to view, use concealed fasteners unless indicated as exposed fasteners or welded joints, or unless otherwise indicated on final shop drawings.

E. Mill all exposed joints to a tight, hairline fit, flush and smooth. Miter exposed corner joints as indicated and machine fit to hairline joint. Joints shall be securely and neatly tenoned, drawn together using concealed fasteners. Locate joints where indicated or accepted on final shop drawings.

F. Cut shapes to pattern, sizes, and dimensions as detailed and approved. Punch and drill holes accurately, maintaining proper edge and end clearance and proper diameter to fit each fastening. Countersink holes for flat head wood screws.

G. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

H. Weld corners and seams continuously 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.

I. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

J. Furnish and shop assemble all items true to measurements taken at the job, disassembled and ship to the job, complete with all sleeves, bolts, etc., necessary for erection.

K. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

L. Mark each member or assembly of members with erection marks for identification; furnish an erection diagram with marks as detailed. Ship assembled units in such a manner that they may be transported and unloaded without being excessively stressed, deformed or otherwise damaged. Place fabricated material on skids, off the ground; keep clean and properly drained.

M. All welding performed by AWS certified welders and in accordance with AWS D1.1. Perform welding, brazing, and soldering such that surface exposed to view in completed Work will be free of pitting, runs, spatter, cracks, warping, dimpling, depressions, distortion, discoloration and other imperfections. Grind exposed welds to match adjacent finish. Welds shall not be visible on finished surface.

N. Grind exposed ends and cut edge of all items smooth and slightly beveled to remove sharpness, burrs, and cutting marks. Use gas cutting torch in the field to cut holes or correct fabrication errors only after submitting each condition to Architect for review.

O. Fabrication tolerance for flat surface shall be ±1/32-inch in 2-feet measured in every direction at any location with no evidence of oil canning.

P. Separate dissimilar metals fabricated under this Section and metals of this Section that contact metals of other construction with separator recommended by fabricator to prevent corrosion and galvanic action. Do not extend coating onto exposed surfaces.

2.4 STEEL FINISHES

A. Hot-dip galvanized finish per ASTM A123, Coating Grade 60 for all steel and iron items, and ASTM A123, Coating Grade 90 for sheet metal exposed in exterior locations, and elsewhere as called on the Drawings. One shop coat rust inhibiting primer paint on all other items whether concealed or exposed, except do not prime surfaces to be bonded into concrete or masonry, at friction type connections or surfaces within 2-inches of bolts or welds.

B. Stainless Steel: Remove or blend tool and die marks and stretch lines into finish. Grind and polish surfaces to produce uniform directionally textured, No. 4 polished finish, free of cross scratches. Run grain with long direction of each piece.

PART 3 EXECUTION

3.1 ERECTION

A. Furnish items to other trades when setting and installation is part of their Work.

B. Do not set permanent bolting or welding until as much of the assembly as will be stiffened thereby has been properly aligned and within tolerances.

C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

D. Set steel elements accurately to the lines and elevations indicated. Align and adjust the various members before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

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. Field Welding: Comply with the following requirements:

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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. At completion of erection, grind exposed welds smooth, touch-up paint field bolts and welds and abrasions with the same paint used for shop painting or galvanized repair paint on galvanized items.

END OF SECTION

TEMPERED GLASS RAILING ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services required for the structural design and installation of tempered glass and stainless steel clad aluminum railings in locations as detailed.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.

2. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."

C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.

b. Concentrated load of 200 lbf applied in any direction.

c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.

b. Infill load and other loads need not be assumed to act concurrently.

3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

D. Manufacturer's Pre-Tested System: When using a standard pre-tested system in lieu of an Engineered Design, submit copies of manufacturer’s literature or ICC Report indicating compliance with structural performance requirements.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made by Owner. Retesting of products that fail to meet specified requirements shall be done at Contractor's expense.

1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.

2. Test railings according to ASTM E 894 and ASTM E 935.

B. Preconstruction testing not required on manufacturer's pre-tested systems.

1.4 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

1. Product Data: Manufacturer's product lines of railings assembled from standard components.

2. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

3. Samples for Verification: For each type of exposed finish required.

4. Assembled Samples of railing systems, made from full-size components, including top rail, and infill. Show method of finishing members at intersections. Samples need not be full height.

5. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

6. Qualification Data: For qualified professional engineer.

7. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

A. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

1.6 PROJECT CONDITIONS

A. Field Measurements:

1. Where tempered glass handrails and railings are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

2. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating tempered glass handrails and railing without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

1.7 COORDINATION AND SCHEDULING

A. 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. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Transparent structural glass railing assembly by CR Laurence Co.

B. Other Approved Manufacturers:

1. Blumcraft of Pittsburgh.

2. Julius Blum.

C. Other Manufacturers: Submit Substitution Request prior to bid date in accordance with Division 1 Section "Product Requirements."

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Extruded Shapes: ASTM B 221 (ASTM B 221M), Alloy 6063-T52.

C. Product: Blumcraft RG-100SSA glazing systems for 1/2-inch glass, satin anodized finish.

D. Aluminum top rail: _____ .

2.5 GLASS AND GLAZING MATERIALS

A. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials.

1. Glass Color: Clear.

2. Thickness for Structural Glass Balusters: As required by structural loads, but not less than 1/2-inch (12.0 mm) thick.

3. Manufacturer: PPG Industries "Herculite."

B. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.

1. Glazing Cement: Nonshrinking organic cement designed for curing by passing an electric current through metal subrail holding glass panel, as standard with manufacturer.

2. Setting Blocks: EPDM rubber setting and centering blocks.

2.6 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Aluminum Components: Type 304 stainless-steel fasteners.

2. Dissimilar Metals: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring 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.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Post-Installed Anchors: Stainless steel Alloy Group 1 (A1), stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.7 FABRICATION

A. General: 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. Form work true to line and level with accurate angles and surfaces.

C. Connections: Fabricate railings with nonwelded connections unless otherwise indicated.

D. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

E. Close exposed ends of hollow railing members with prefabricated end fittings.

F. Fittings and Anchors: Provide miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

G. Provide inserts and other anchorage devices for connecting railings to concrete substrate. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.8 GLAZING PANEL FABRICATION

A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces

2. Polish exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

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 have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. 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 1/8 inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

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.

3.2 INSTALLING GLASS PANELS

A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.

1. Attach base channel to building structure, then insert glass into base channel and bond with glazing cement.

a. Support glass panels in base channel at quarter points with channel-shaped setting blocks that also act as shims to maintain uniform space for glazing cement. Fill remaining space in base channel with glazing cement for uniform support of glass.

2. Adjust spacing of glass panels so gaps between panels are equal before securing in position.

3. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Payment for these services will be made by Owner.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Railings will be tested according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and will comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Clean glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

3.5 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.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the installation of all rough carpentry, including plates, studs, fire stops, solid blocking, bridging, bracing, posts, blocks, subfloor sheathing, and rough hardware.

B. The General Structural Notes shall be used in conjunction with these specifications. The General Structural Notes shall supersede items in this specification when discrepancies exist.

1.2 REFERENCES

A. American Institute of Timber Construction (AITC).

B. American Lumber Standards Committee (ALSC).

C. American National Standards Institute (ANSI).

D. American Society for Testing and Materials (ASTM).

E. American Wood Preservers' Association (AWPA).

F. APA - The Engineered Wood Association.

G. International Code Council (ICC).

H. Voluntary Product Standard (PS).

I. West Coast Lumber Inspection Bureau (WCLIB).

J. American Forest and Paper Association (AF&PA).

K. Western Wood Products Association (WWPA).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Composite wood manufacturer certification of compliance with requirement for no added urea-formaldehyde resins in composite wood products.

C. Shop drawings of the following building components, bearing the seal of a structural engineer licensed in the State of Oregon:

1. Wood I-joists.

2. Open web joists.

3. Glue-laminated beams.

D. Certificate of Conformance with Attachments 1 and 2 indicating compliance with AITC or APA requirements.

E. Certification of conformance to treated lumber requirements.

1.4 QUALITY ASSURANCE

A. Materials shall be grade stamped equal to or better than the grades hereinafter called for according to the following associations governing their various species of lumber products:

1. American Institute of Timber Construction (AITC).

2. APA - The Engineered Wood Association.

3. Unless otherwise noted, moisture content of material shall conform to WCLIB Rule No. 16, General Grading Provisions, Paragraph 3, Seasoning Provisions.

B. Treated Lumber: Inspection of material for conformity to the requirements of this specification shall be in accordance with AWPA Standard M2, Standard for Inspection of Treated Timber Products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Wrap, cover, and protect lumber products in shipment and while stored on site to prevent weather exposure and damage. Maintain stocks neat and in good order, level and off ground or floors, raised on pallets or dunnage to prevent contact with water.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate with Division 7 Section "TPO Single Ply Membrane Roofing" for installation of roof insulation stops and sleepers, and plywood decking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed in Paragraph 2.2, Materials.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Framing Lumber:

1. Structural Light Framing: WWPA No. 2, kiln dried, Douglas-fir/larch.

2. Beams and Stringers: WWPA No. 1, kiln dried, Douglas-fir/larch.

3. Posts and Timbers: WWPA No. 1, kiln dried, Douglas-fir/larch.

B. Treated Lumber:

1. Decay Resistance-Treated Lumber: No. 2 S4S Douglas-fir, shall be pressure-treated with ammoniacal copper quaternary (ACQ) or copper azole (CA) in accordance with AWPA Standard U1, minimum Use Category UC2 . All pressure-treated lumber shall bear the AWPA Use Category quality mark. Lumber marked "treatment to point of refusal" is not acceptable.

a. ACQ Products: "Nature Wood" by Osmose, 800/241-0240; "ACQ Preserve" by Chemical Specialties, Inc., 800/421-8661. Do not use in contact with single ply roof membranes.

b. CA Products: "Natural Select" by Arch Wood Protection, Inc., 866/789-4567.

C. Subfloor, Wall Sheathing and Roof Sheathing: Structural-Use panels of all-veneer construction, Group 1, APA Rated Sheathing, Exposure 1, C-D, thickness as detailed, span rating to match support spacing. Roof sheathing under singly ply membrane roofing shall be 5/8-inch thick plywood.

1. Shear Wall Attachment:

a. Structural panels shall be permitted to be attached to steel framing with a minimum No. 8, countersunk tapping screws with a minimum head diameter of 0.285 inch or No. 10, countersunk tapping screws with a minimum head diameter of 0.333 inch, in accordance with AISI Table C2.1-3.

b. Screws used to attach wood structural panel sheathing shall be in accordance with ASTM C1513.

D. Plywood for Equipment Boards: 3/4-inch thick APA Group 1, C-D, UL FR-S label.

E. Glue-Laminated Beams:

1. Lumber for laminating shall meet the Structural Requirements of Laminating Specifications, Voluntary Product Standard PS56, for Structural Glue Laminated Timber, and AITC 117. Stress Grades of beams to provide glue-laminated members with allowable values as detailed. All members fabricated with waterproof adhesive, camber as noted, and in conformance with ANSI A190.1.

2. Beams in concealed spaces shall be Industrial Appearance Classification.

3. End seal all members and protect in transit and against weather.

F. Gypsum Sheathing: ASTM C1177, core treated, fiberglass faced, mildew resistant ASTM D3273, water-repellent gypsum sheathing, 5/8-inch thick, 48-inches wide, length as required, Type X fire retardant, UL labeled and ICC approved.

1. G-P Gypsum Corporation "DensGlass Fireguard."

2. BPB America, Inc., "GlasRoc Sheathing."

3. National Gypsum, "Extended Exposure XP."

G. Separation Felt: 30 lb. asphalt saturated roofing felt, ASTM D226, Type II.

H. Anchor Bolts: ASTM F1554, Grade 36, American made machine thread cut bolts, 5/8-inch full diameter, 10-inches long unless noted otherwise on Drawings, with 2-inch hooked end, complete with nut and washer.

I. Framing Connectors:

1. ICC approved stock framing connectors, G90 galvanized ASTM A653, (G185 galvanized ASTM A653 or Type 304 stainless steel in contact with treated lumber) , rated according to recorded tests. Provide special framing anchor nails as required and other fastenings as detailed and normal for installation.

2. Manufacturers: K.C. Metals "Superspeed Connectors," Silver, and Simpson Strong Tie.

J. Wood I-Joists:

1. Wood web joists manufactured with ICC approval. Joists formed of APA oriented strand board webs and laminated veneer lumber flanges.

2. Size and detail joists to fit dimensions and loads as detailed.

3. Manufacturers: Trus-Joist, Boise Cascade, and Willamette Industries.

K. Open Web Joists:

1. Truss type joists shall be ICC approved. Joists formed of laminated veneer lumber or machine stress rated lumber flanges with pin connected steel tube web members.

2. Size and detail joists to fit dimension and loads as detailed.

3. Manufacturers: RedBuilt and Web Joist.

L. Fasteners:

1. Power-Driven Fasteners: NES NER-272.

2. Lag Bolts: ASME B18.2.1.

3. Nails, Brads, and Staples: ASTM F 1667.

4. Wood Screws: ASME B18.6.1.

5. Type S-12 screws, bugle or pan head as required, ASTM C954.

6. Bolts: Steel bolts complying with ASTM A 307, Grade A, with ASTM A 563 hex nuts and, where indicated, flat washers.

7. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

   a. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

   b. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2, for use with treated lumber.

M. Fasteners for Treated Lumber: G185 galvanized ASTM A653 or Type 304 stainless steel in contact with decay-resistant treated lumber or fire-resistant treated lumber.

N. Construction Adhesive:

1. Water dispersed industrial adhesive.

2. Manufacturers: 3M Co. "Scotch-Grip" 4289-NF.

O. Sill Seal Foam: Dow “Weathermate Sill Seal,” 5-1/2-inch wide, flexible, closed-cell polyethylene foam gasketing strip.

PART 3 EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions.

D. Do not splice structural members between supports, unless otherwise indicated.

E. Selection and placement of exposed wood products: All wood products designed to be left exposed to view in the completed building shall be selected for good appearance, free of wanes, heartwood, pitch pockets, splintering, checking, banding indentations, grade stamps, and other defacements.

F. Cut and repair framing where required by electrical, mechanical or other mechanics throughout the job. Boring of holes for pipes and conduits not included. Where cutting is required in a structural member that is likely to weaken the construction, consult with the Architect as to the measures taken in order to perform the work without causing any deficiencies of strength or workmanship. Close all openings with incombustible material where pipes and ducts pass through framing.

G. Accurately fit all connections as detailed, all bolt holes drilled and properly sized to the bolts. Predrill lag and wood screw holes. Washers required under head and nut of all wood connections.

H. Nailers, Cants and Crickets: Include rough carpentry as detailed and specified for installation of roofing and miscellaneous nailers. Use pressure-preservative-treated lumber throughout. Build wood framed curbs and nailers for support and anchoring of flashing and equipment as detailed. Permanently attach to roof deck, walls, and other work with approved fasteners, two or more fasteners per member and spaced at not over 36-inches o.c. Securely nail all splices, laps and built-up members.

I. Sills and Plates: Use pressure-preservative-treated sills and plates in all conditions where bearing on concrete or masonry. Place sill seal foam between sill and concrete and draw down with anchor bolts as detailed. Double top plate on all partitions with end joints lapped and staggered. Reinforce top plates where cut for electrical and mechanical work with 16 gauge metal splice plates.

J. Studs, Caps and Headers: Use straight material throughout; twisted material not permitted. Set all items as necessary for rigid frame.

K. Joists: All joists evenly spaced.

L. Joist Bridging: Unless specifically noted on the Drawings, intermediate joist bridging not required where joists ends are prevented from rotation by solid blocking or an approved joist hanger. The top of each joist laterally supported by structural nailing of sheathing and sheathing nailed to blocking at ends of joists, and temporary support provided during construction.

M. Headers: Install over all openings. Fabricate from two or more members on edge with shims as required, spike solidly together. Install stud and cripple minimum at each rough jamb. Minimum schedule unless otherwise noted on Drawings.

1. Up to 4-feet inclusive: Two 2 x 6.

2. 4-feet to 6-feet inclusive: Two 2 x 8.

3. 6-feet to 8-feet inclusive: Two 2 x 10.

4. Over 8-feet: As detailed.

N. Beams: Install in locations as detailed, anchoring solidly. Stay and brace members in position until all connections are complete. Handle and protect specially wrapped or prepared items to avoid damage or scarring.

O. Firestops and Blocking:

1. Install as detailed and in no case more than 120-inches apart vertically and horizontally, in exterior and interior wood stud walls throughout. Fire block at ceiling line where wall finish does not continue above ceiling.

2. Fire block in concealed spaces between stair stringers, at the top and bottom of the run and between studs along and in line with the run of stairs, if the walls under the stair are unfinished.

P. Wood Contacting Concrete or Masonry: Wherever joists, beams, rafters, etc., make end or side contact against concrete or masonry walls and slabs, install two layers of 30 lb. roofing felt so there will be no contact between wood and concrete.

Q. Treated Wood Contacting Metal: Wherever decay-resistant treated wood comes in contact with any type of metal, install one layer of 30 lb. roofing felt so there will be no contact between wood and metal.

R. Gypsum Sheathing**:** Horizontal application with end joints centered on studs and staggered. Nail through sheathing to framing with 11 gauge hot-dip galvanized nails 1-1/2-inches long with 3/8-inch head, at 4-inches o.c.

S. Subfloor, Wall Sheathing and Roof Sheathing Structural-Use Panels:

1. Secure sheathing panels with nail size and pattern as detailed. Lay panels with face grain perpendicular to the supports with joints in adjacent panels staggered and butted at center line of joists.

2. Apply 1/4-inch diameter continuous bead of construction adhesive to tops of joists, blocking, and plates immediately prior to placing subfloor panels.

3. Install subfloor panels with 1/8-inch space between sheets and clearance at boundary walls and rigid penetrations through floor.

4. Provide blocking or "Ply-Clips" at unsupported edges of roof sheathing as detailed and whenever framing is spaced more than 16-inches o.c. Install with plugged face up.

T. Equipment Boards: Secure equipment mounting boards 8-inches o.c. at each stud, "C" face exposed.

U. Wood I-Joists and Open Web Joists:

1. Store and maintain members in upright position at all times and protect from weather.

2. Install in position and support as detailed. Maintain members plumb with chords held straight with temporary bracing in addition to required bridging to assure adequate lateral support for the system until sheathing has been applied. Temporary construction loads beyond design limits are not permitted.

V. Blocking and Backing: Verify that solid blocking or backing is provided in framing for attachment of all wall and ceiling mounted items and equipment. Coordinate specific blocking requirements of all items specified in each specification Section that mount on walls and ceilings. Use templates and fastening devices furnished with item or appropriate screws and bolts. Check Hardware Schedule for locations of wall door bumpers. Do not fasten solely to wall and ceiling finish materials.

W. Deflection Head Construction: Required at the top of all non-bearing wall partitions that occur under open-web type framing members. Allow 3/4-inch space between top plate of wall and bottom truss chord for deflection tolerance.

X. Fasteners in Withdrawal: Non-structural wood components held in place with fasteners that would be in withdrawal loading after the final assembly is complete shall be fastened with bugle head screws with the same frequency as scheduled for nails. Screws shall be minimum length to penetrate substrate 1-1/2-inches.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections: The Owner will employ the services of an independent testing laboratory for conducting inspection services on plywood nailing and as noted within the Statement of Special Inspections on the Structural Drawings.

END OF SECTION

ENGINEERED WOOD PRODUCTS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services necessary for the installation of structural composite lumber.

B. The General Structural Notes shall be used in conjunction with these specifications. The General Structural Notes shall supersede items in this specification when discrepancies exist

1.2 REFERENCES

A. ICC Evaluation Service, Inc.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section “Submittal Procedures.”

B. Shop Drawings: Submit shop drawings, showing materials, member sizes, dimensions, hardware, anchorage and relationship to adjacent materials.

1.4 QUALITY ASSURANCE

A. Grade Identification: Identify all by official grade mark showing compliance with ICC ER4979 requirements or provide inspection certificates from appropriate grading and inspecting agencies.

B. Erectors: Experienced in the erection of structural composite lumber and capable of showing evidence of having successfully completed projects of similar scope and complexity.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Manufacturers: RedBuilt and Trus Joist.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section “Product Requirements.”

2.2 MATERIALS

A. The wood species, species combinations, and adhesives used to manufacture composite lumber items are specified in the approved Quality Control Manual and Manufacturing Standard prepared by the engineered wood product manufacturer.

1. PSL: Parallel Strand Lumber, 2.0E.

2. LSL: Laminated Strand Lumber, 1.6E.

3. LVL: Laminated Veneer Lumber, 1.9E.

2.3 FABRICATION

A. Shop fabricate all members in continuous lengths with grain parallel to the length, and in accordance with Reference Standards.

PART 3 EXECUTION

3.1 PRECONDITIONS

A. Examination: Examine surfaces to receive structural composite lumber and conditions under which it is to be installed. Correct unsatisfactory surface or conditions prior to commencement of installation.

3.2 WORKMANSHIP

A. General: Install in accordance with reference standards, requirements of governing authorities, notes on Drawings, and as follows.

1. Framing:

a. Erect plumb, true, securely anchored, accurately aligned, with all required fastenings, and accessories.

b. Tolerances: On all joists to receive finished surfaces, align so that difference in plane from adjacent members is 1/8-inch or less at any point.

2. Joints: Accurately cut and solidly fit to provide strong, rigid joints with full bearing for members. Shimming will not be permitted.

3. Sloping Members: Cut or notch as required to provide uniform bearing surfaces.

B. Cutting of Members: Cut members as shown on the Structural Drawings for passage of pipes, and conduits. Obtain permission of Architect prior to performing cutting not specifically shown.

C. Reinforcement: Unless otherwise detailed or required by governing authorities, reinforce locations where cutting is performed with 1/8-inch x 3-inches x 18-inches galvanized steel straps punched for 10d nails on 6-inch centers.

END OF SECTION

FINISH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the installation of finish carpentry.

B. Related Section: Related Section: Division 9 Section “Painting” for finishing of wood products.

1.2 REFERENCES

A. Architectural Woodwork Quality Standards (AWS): Architectural Woodwork Standards, Guide Specifications and Quality Certification Program, Edition 1, adopted and published jointly by Architectural Woodwork Institute, Architectural Woodwork Manufacturers Association of Canada and The Woodwork Institute.

B. APA - The Engineered Wood Association.

C. National Hardwood Lumber Association (NHLA).

D. Voluntary Product Standard (PS).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings showing details and profiles of all special molding and other special run millwork.

1.4 QUALITY ASSURANCE

A. Quality Grade: Unless otherwise specified, perform work and provide products in accordance with AWI/AWMAC/WI Architectural Woodwork Standard (AWS), Premium Grade.

B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1. Single Source Responsibility: Provide and install this work from single fabricator.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Protect finish materials from dirt and moisture during delivery and while stored on the job. Store at site in a protected dry area with heat and ventilation as required to keep lumber dry. Do interior work only in areas where wet work has been completed and work area is dry, heated and ventilated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed in Paragraph 2.2.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. **Hardwood Door Frames and Trim: NHLA FAS (firsts and seconds), white oak, kiln dried.**

B. WDPNL 1, Wood Wall Panel: Hakwood “Duoplank European Oak,” color “Authentic Collection Original,” engineered wood flooring used as wall finish.

1. Size: 7-inches wide x 3/4-inch thick.

2. Finish: Premier 1-bis micro bevel.

C. WB 1, Wood Base: WWPA Finish Grade (graded one face and two edges) “Superior” spruce, kiln dried, paint finish.

D. Moisture Content: Kiln dry finish lumber and molding to 15% maximum moisture content.

E. Nails: Finish nails for all face nailing. Use nail size as required for material and in lengths necessary to penetrate solid framing.

F. Screw Nails: Rockler metal piercing trim head square drive screws for all face nailing. Use screw nail size as required for material and in lengths necessary to penetrate solid framing.

G. Adhesive: Marsh, Miracle Adhesive, 3M Co., or U.S. Plywood Weldwood.

PART 3 EXECUTION

3.1 INSTALLATION

A. Cutting, Fitting and Jointing: Install standing and running trim and boards in one-piece continuous lengths wherever practical with no spliced piece less than 6-feet long. Scarf end splices and make inconspicuous, with end grains matched if work is transparent finished. Miter outside intersecting corners of trim and molding, cope inside corners. Miter and return at exposed ends of trim to conceal end grain.

B. Nailing: Set heads for putty stopping.

C. Workmanship: Work to AWS Premium Grade standards throughout. Vertical grain on exposed principal face of all members as directed by Architect. Finish sand all work and leave smooth and dirt free, without blemishes visible through finishes as scheduled. Remove and replace or resurface all work showing hammer marks, splits, tool marks, torn grain, and other appearance of defective workmanship as directed by Architect.

END OF SECTION

ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes but is not necessarily limited to the following architectural millwork:

1. Wood veneer paneling at walls.
2. Solid wood slats.
3. Wood trim and base.
4. Plastic laminate and wood veneer casework.
5. Solid lumber shelving.
6. Display case.

1.2 REQUIREMENT OF REGULATORY AGENCIES

A. Comply with all national, state and local codes including:

1. Building codes.
2. Environmental codes.
3. Fire codes: Where required by code, all materials must be fire rated. Except for enclosed exitways and corridors, a Class C interior finish (76 to 200 flame spread) is required. In corridors, Class B interior finish (26 to 75 flame spread) is required.
4. Codes of any other regulatory agency having jurisdiction.

1.3 REFERENCES

A. Standards: The following referenced standards and standard specifications, referred to thereafter by designation only, form a part of this Section.

1. American National Standards Institute (ANSI):
   a. ANSI A208.1-1987, Mat-Formed Wood Particleboard.
   b. ANSI A208.2-1980, Medium Density Fiberboard for Interior Use.
   c. ANSI/AHA A135.4-1982, Basic Hardboard.
2. American Society for Testing and Materials (ASTM):
   a. D523-89, Test Method for Specular Gloss.

b. D2898-81 (1986), Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.

c. E84-89a, Test Method for Surface Burning Characteristics of Building Materials.

3. Architectural Woodwork Quality Standards (AWS): Architectural Woodwork Standards, Guide Specifications and Quality Certification Program, Edition 1, adopted and published jointly by Architectural Woodwork Institute, Architectural Woodwork Manufacturers Association of Canada and The Woodwork Institute.

4. National Particleboard Association (NPA):

a. NPA 8-86, Voluntary Standard for Formaldehyde Emission from Particleboard.

b. NPA 9-87, Voluntary Standard for Formaldehyde Emission from Medium Density Fiberboard (MDF).

5. National Electrical Manufacturers Association (NEMA): NEMA LD 3-91, Application, Fabrication, and Installation of High-Pressure Decorative Laminates.

6. Hardwood Plywood and Veneer Association (HPVA): ANSI/HPVA HP-1-2009, American National Standard for Hardwood and Decorative Plywood.

7. National Hardwood Lumber Association (NHLA).

8. U.S. Voluntary Product Standard (PS): U.S. Voluntary Product Standard PS 1-83, Construction and Industrial Plywood.

9. Western Wood Products Association (WWPA).

1.4 DEFINITIONS

A. Exposed Surfaces: Surfaces visible when doors and drawers are closed; bottoms of casework more than 4-feet above finished floor, backs of hinged doors and edges of hinged doors exposed when opened, visible surfaces of open shelving and surfaces behind glass doors.

B. Semi-Exposed Surfaces: Surfaces that become visible when drawers and doors are opened, tops of cases 6-feet, 6-inches or more above finished floor.

C. Concealed Surfaces: Surfaces not visible after installation.

1.5 SUBMITTALS

A. Submit the following in accordance Division 1 Section “Submittal Procedures.”

B. Product Data:

1. Include catalog cuts for cabinet hardware and other equipment.

2. Provide samples for hinges, catches, door/drawer pulls, cabinet locks and locker locks.

C. Shop Drawings:

1. Submit shop drawings of woodwork showing location of each item, dimensioned plans and elevations, grain direction, large scale details, joints, sections and connections to adjacent work.

2. Include details of framing, blocking and furring and coordination for interface work at substrates.

3. Include hardware schedule for cabinet hardware.

D. Samples:

1. Solid lumber members and running trim: 18-inch long x full width x full depth sections of each type of molded trim and solid lumber shelving for each required profile and finish, including fire retardant treatment.

2. Paneling: 18-inch square x full depth corner samples with typical reveal detail for each required profile.

3. Stained and transparent finished samples: Submit two sample sets for each species, showing full range of grain, color, texture and finish.

4. Plastic laminate finished samples: Submit 4-inch x 4-inch of each pattern specified.

5. Provide one sample cabinet of each cabinet type, showing typical joint conditions, fabrication methods, quality of door and drawer hardware, and quality of finishes and workmanship.

E. Composite wood manufacturer certification of compliance with requirement for no added urea-formaldehyde resins in composite wood products.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm with at least 5 years experience in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. Single-Source Manufacturing and Installation Responsibility: Engage a qualified manufacturer to assume undivided responsibility for woodwork specified in this Section, including fabrication, finishing, and installation.

C. Grade of Architectural Woodwork: Conform to AWS "Premium Grade" standards for material, fabrication and installation.

D. Solid surface materials (SURF) shall only be fabricated and installed by a professionally trained fabricator and/or installer for each material type. A detailed knowledge of the properties of each

material and the proper installation practices is required to reduce the probability of improper installation.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Storage: Storage areas shall be clean and the relative humidity held steady within 25% to 55%.

1.8 PROJECT CONDITIONS

A. Verify dimensions before proceeding and obtain measurements at job site for work required to be accurately fitted to other construction. Measurements shall be accurate so that finished work is precisely assembled and fitted.

B. Report unsatisfactory tolerances in adjoining work.

C. Proceed with woodwork only after substrate construction and penetrating work have been completed and if necessary, corrected by other trades.

1.9 WARRANTY

A. Woodwork: Provide one-year warranty agreeing to repair or replace work which is not in conformance with requirements of Contract Documents or work that becomes out of adjustment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers:

1. Artek Contracting, Inc., 503-641-6877.

2. Milltech Group, 800-755-3092.

3. Uncommon Cabinetry, Inc. 541-929-2701.

4. Burgener’s Woodworking, 360-694-9408.

5. Custom Source Woodworking, Inc., 360-491-9365.

6. J.S. Perrott, 503-234-1880.

7. Advance Cabinet Designs, 541-465-3394.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 SOLID LUMBER MATERIALS

A. Wood Solid Stock:

1. General: Comply with AWS Section 3 lumber grading rules for Grade I work. Provide lumber surfaced four sides (S4S) and work to patterns indicated.

2. WD 1, solid wood slats: Premium grade white oak.

3. WD 2, hardwood for edgebanding and trim: Premium grade white oak.

B. Blocking, Framing and Furring:

1. Sound, thoroughly-seasoned, and free from warp that cannot be corrected in process of bridging or nailing. Use same species for members in any one assembly.

2. Grades for framing materials: Conform to grading rules of The Softwood Manufacturer's Association for species of wood being used.

2.3 WOOD VENEER CASEWORK AND PANEL MATERIALS

A. General:

1. Comply with AWS Section 4 veneer face grade description for Grade AA veneers.

2. Provide thicknesses as indicated; if not indicated, provide minimum thicknesses required by AWS for Grade AA veneers.

3. Wood veneer for clear finish:

a. AWS Premium AA face, white oak, quarter sawn, narrow heart figure.

b. Minimum thickness 1/28-inch at 12% moisture content.

c. Manufactured from veneer leaves of equal width, book and balance match on the panel. Horizontal grain to be end, book, and butt matched.

4. Panel Core:

a. Fire rated particleboard, Class 1 fire rating, meeting UL standards for surface burning characteristics of building materials, UL 223, 45 lb. density Industrial Grade, 3/4-inch thick.

b. Manufacturers: "Duraflake FR" by Flakeboard Company, Ltd. 877-273-7680.

5. Back: Hardwood back grade veneer of a similar species to balance face veneer.

6. Edges: Provide solid white oak edging as detailed on all four edges.

B. Panel Clips for Wall Panels: Brooklyn Hardware "Panel Clip," 503-232-1151.

C. **Fire Retardant Treatment: American Flamecoat "Flame Control 122W," 206-789-9404.**

2.4 RUNNING TRIM

A. **WB 2:** Woodbase, 6-inches high, premium white oak.

2.5 CABINET HARDWARE

A. Hinges:

1. Door hinges: Concealed hinges for full overlay doors, 170 degrees opening with integral horizontal and vertical adjustment; self-closing.

2. Approved Manufacturers: Julius Blum, Inc., and Grass America, Inc.

3. Door hinge quantity:

a. Two hinges for doors up to 36 inches high, 24 inches wide.

b. Three hinges for doors up to 48 inches high, 24 inches wide.

c. Four hinges for doors up to 82 inches high, 24 inch wide.

B. Drawer Slides:

1. Description: Full extension ball bearing slides. Julius Blum, Inc., and Accuride approved.

2. Mounting: Side.

3. Load capacity:

a. Desk drawers: 75 pounds per pair.

b. Bins and file drawers: 150 pounds per pair.

C. Pulls:

1. Plastic laminate faced casework: Hafele America 115.61.601, stainless steel, satin sheen.

2. Wood casework: Hafele America 115.61.601, stainless steel with threaded breakoff screw, M4 022.35.887.

3. Lateral file drawers and where noted: Hafele America 126.27.904 integrated pull, anodized aluminum, satin sheen.

D. Shelf Support Pin:

1. 5mm bored holes at 32mm o.c. with shelf pins.

2. U. S. Tek, 626-859-9225 "Engstrom #11 Seismic Shelf Clip," double pin, 500 lb. capacity.

3. Location: Open and concealed shelving.

E. Cable Holes: Holes in countertops covered with high impact ABS cable hole covers with spring closure top, Hafele America Co. Series 429.99, color compatible with countertop. Equal products manufactured by Doug Mockett approved.

F. Drawer and Door Locks:

1. Description: 5 pin tumbler, interchangeable core, keyed to building master, 2 keys per lock. Provide spacers to install lock flush with face of cabinet.

2. Finish: Brushed stainless steel 626.

3. Locations: Provide for each door and drawer where indicated.

4. Manufacturer: Schlage Lock CL777R (door) and CL888R (drawer).

2.6 PLASTIC LAMINATE CASEWORK

A. High Pressure Plastic Laminate (PL) Faces: 0.030 grade NEMA Type 1 on exposed faces including open shelving. Balance back sheet 0.020-inches thick on concealed portion of work.

B. PL Colors: Refer to Division 9 Section “Finish Legend.”

C. COUNTERTOP 1, Solid Acrylic Countertops: Basix International Quartz Surface, 1-1/4-inch thick solid, non-porous, mineral filled acrylic resin, polished surface, color Alpine.

1. Accessories: Mounting adhesives, surfacing adhesives, joint sealants, and cleaning solvents of type recommended by manufacturer for application and conditions of use.

D. Plywood in Sink Counters: HPVA hardwood plywood, exterior glue, 3/4-inch thick.

E. Particleboard Core Stock: 3/4-inch thick, complying with ANSI A208.1, 45 lbs./cu.ft. density, minimum average modulus of rupture of 2400 psi, minimum average modulus of elasticity of 400,000 psi.

F. Semi-Exposed Surfaces, Cabinet Shelves, and Partitions: Low pressure laminate (LPL) (polyester or melamine) laminated to particleboard with edge banding of the same material where edges are exposed. Color to be selected by Architect. Shelves 3/4-inches thick for spans up to 32-inch, 1-inch thick for spans from 32-inches up to 42-inches. Low pressure laminate on all semi-exposed surfaces.

G. Open Shelving:

1. PL face on shelf top and front edge. Balance sheet on shelf underside. Shelves 1-inch thick particleboard for spans up to 42-inches.

2. Shelf Hardware: Knape & Vogt heavy duty standard 87 and heavy duty bracket 186. Length of bracket shall match shelf depth.

H. Frame Stock: No. 1 shop kiln dried Douglas-fir.

I. Drawer and Door Edge Banding, Edge Banding on Open Shelves and Edges Behind Drawers and Doors: 3mm PVC, color to match plastic laminate.

2.7 FABRICATION

A. Fabrication:

1. Comply with referenced AWS standards.

2. Provide details and profiles indicated.

3. Fabricate units rigid, neat, free from defects, warp or buckle in accordance with final shop drawings.

4. Provide factory cutouts for openings in units as required to receive associated work.

5. Assemble prefinished units at the factory to the greatest degree possible and disassemble only as required for shipping to the site. Accurately mark units for assembly at site.

B. Running Trim:

1. Comply with AWS Section 6, Premium Grade.

2. Fabricate white oak trim and base from solid stock material for clear finish.

C. Cabinets:

1. Comply with AWS Section 10 Premium Grade.

2. Casework with Clear Coating Finish:

a. Drawer fronts and doors: Fabricate from casework core particleboard laminated with face and back veneer, edge banded with solid white oak.

b. Cabinet Sides and Exposed Rails: Casework core particleboard with face and back veneers, edge banded with solid white oak.

c. Edge banding to be applied to the core before laminating except where detailed otherwise.

d. Unexposed framing: Solid hardwood.

e. Prepare units for hardware, install at factory where practical.

3. Casework with Plastic Laminate Finish: Apply high pressure laminate to fronts, faces, and ends, and trim in accordance with AWI Premium grade standards and as detailed and noted on the Drawings.

D. **Paneling:**

1. **Comply with AWS Section 8, Premium Grade.**

2. **45 lb. particle core with veneer faces and solid wood edge banding. Edge banding to be applied to the core before laminating except where detailed otherwise.**

3. **Matching within panels: Book and balance matched.**

4. **Matching between adjacent panels: Blueprint match.**

2.8 SHOP APPLIED FINISH

A. **Fire Retardant Treatment:**

1. **Apply in accordance with manufacturer's instructions to components requiring treatment.**

2. **Verify compatibility with other finishes prior to treatment.**

B. Provide complete factory finish.

C. Finish in strict accordance with requirements of AWS Section 5, Premium Grade.

D. CC-1, Clear Coating:

1. Materials:

a. Sealer: Sherwin-Williams vinyl sealer, T67 F 3.

b. Filler: Sherwin-Williams "Sher-Wood" fast-dry filler.

c. Top Coats: Sherwin-Williams “Acrylic Conversion Coating, Dull Rubbed Effect.”

2. Close Grain Woods Finishing Process: Vertical and horizontal surfaces.

a. Apply one coat sealer with brush or sprayer.

b. Sand, 220 grit.

c. Apply two top coats with sprayer, lightly sand between coats.

3. Add any of the following additional finishing steps in any order prior to top coats as required to achieve a uniform finish without sharp contrast in color or grain.

a. Bleaching.

b. Fillers.

c. Glazing.

d. Toning.

e. Sealers.

f. Washcoats.

E. **CSW-1, Clear Sealer on Wood:**

1. **Sealer: Sherwin-Williams linseed oil.**

2. **Finishing Process: Apply one coat sealer.**

PART 3 EXECUTION

3.1 INSPECTION

A. Examine substrates and adjoining construction and conditions under which work will be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide all necessary blocking, backing, framing, suspension, and other components necessary to provide a complete functioning system in the profile, dimensions, configurations, and materials indicated.

B. Exposed Blocking: Install surface mounted wood blocking, nailers, furring and grounds as required for wall-hung cabinetry and other wall-hung items, whether or not such blocking and similar items are indicated on drawings.

C. Unexposed Blocking: Unexposed internal blocking within the wall construction by others. Location of unexposed blocking to be determined by this trade.

3.3 INSTALLATION

A. General:

1. Comply with AWS Sections 6-Interior and Exterior Millwork, 8-Wall Surfacing, 10-Casework, and 11-Countertops, Premium Grade.

2. Install in accordance with final shop drawings and manufacturer's instructions.

3. Assemble and install work without machine and tool marks.

4. Neatly fit and scribe work to adjacent surfaces.

B. Running Trim:

1. Provide concealed grounds anchored securely to substrates.

2. Install in single lengths without splicing wherever possible, level, plumb and square.

3. Scarf running joints. Stagger joints in adjacent and related members.

4. Cope at returns and internal angles and miter at external angles.

5. Blind nail with fine finishing nails. Set nails for putty stopping.

6. Draw trim tight against finished surface.

7. Coordinate with mechanical, plumbing and electrical requirements to provide openings for diffusers, sprinkler heads, receptacles, switches and fixtures.

C. Wall Paneling and Cabinets:

1. Install with back mounted concealed fasteners, plumb and level, no exposed fasteners.

2. Securely attach to supporting substrates and blocking and furring.

3. Coordinate with electrical requirements to provide openings at receptacles and switches.

D. Countertops:

1. Install countertops straight, level and plumb.

2. Provide concealed grounds and anchor securely to walls.

3. Coordinate with electrical and plumbing requirements to provide openings at receptacles, switches and plumbing fixtures.

4. Solid Surfacing:

a. Verify that substrates supporting quartz surfaces are plumb, level, and flat to within 1/16 inch in ten feet (1.6 mm in 3000 mm), and that necessary supports and blocking are in place.

b. Clean substrates of dust and contamination.

c. Clean quartz surfacing back side and joints with solvent.

d. Apply sufficient quantity of mounting adhesive in accordance with adhesive manufacturer’s recommendations to provide permanent, secure installation.

e. Install surfacing plumb, level, and square and flat to within 1/16 inch in ten feet (1.6mm in 3000 mm).

f. Joints between adjacent pieces of quartz surfacing:

(1) Joints shall be flush, tight fitting, level, and neat.

(2) Securely join with stone adhesive.

(3) Fill joints level with quartz surfacing.

(4) Clamp or brace quartz surfacing in position until adhesive sets.

(5) Joints between backsplashes and countertops: Seal joints with silicone sealant.

3.4 ADJUSTING AND REPAIR

A. Before completion of work, adjust hardware until components operate properly.

B. Replace defective, damaged or missing hardware.

C. Touch-up marred finishes, including shop finishes to match adjacent surfaces.

D. Remove and replace units which are warped, bowed, not properly fitted or finished or otherwise damaged.

3.5 CLEANING AND PROTECTION

A. Clean work upon completion.

B. Protect units during construction so that they will be without any damage or use at time of acceptance.

END OF SECTION

BENTONITE WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the installation of bentonite composite sheet membrane waterproofing systems, accessories and related materials. Furnish all labor, material, equipment, and services required for a foundation waterproof system.

B. Related Sections:

1. Division 3 Section “Concrete Forming and Accessories.”

2. Division 33 Section "Subdrainage."

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D746, Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

2. ASTM D1149, Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber.

3. ASTM D1204, Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.

4. ASTM D1621, Test Method for Compressive Properties of Rigid Cellular Plastics.

5. ASTM D1777, Method for Measuring Thickness of Textile Materials.

6. ASTM D3776, Test Method of Mass per Unit Area (Weight) of Woven Fabric.

7. ASTM D4491, Test Methods for Water Permeability of Geotextiles by Permittivity.

8. ASTM D4533, Test Method for Trapezoid Tearing of Strength of Geotextiles.

9. ASTM D4632, Test Method for Breaking Load and Elongation of Geotextiles (Grab Method).

B. Federal Testing Material Standard, FTMS 101B.

1.3 SYSTEM DESCRIPTION

A. General: Provide waterproofing products and related accessories, produced and installed to establish and maintain watertight continuous seals and conditions.

1.4 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product data and general recommendations from waterproofing materials manufacturer for types of waterproofing required.

C. Data sheets indicating tensile strength, puncture resistance, permeability, elongation and water migration, as verified by independent testing laboratories.

D. 6-inch x 6-inch samples of sheet membrane waterproofing, drainage core, tapes, fasteners, and auxiliary materials as requested by the Architect.

E. Submit certificate from installer, obtained from manufacturer, that installer is an approved applicator. Certificate shall clearly indicate that installer has been trained to install materials and systems specified herein in applications indicated.

F. Manufacturer's warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer: Obtain primary waterproofing materials of each type required from a single manufacturer, to greatest extent possible. Provide secondary materials only as recommended by manufacturer of primary materials.

B. Installer: Certified by the manufacturer as an approved applicator.

C. Pre-Installation Meeting: Prior to installation of waterproofing and associated work, meet at project site with waterproofing installer and installers of each component of associated work, including manufacturer's representatives and inspection personnel, to coordinate related requirements with waterproofing work. Review material selections and procedures to be followed in performing work. Notify Architect at least 48 hours before conducting meeting.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturers original containers and bindings with seals and labels intact.

B. Store materials off ground. Cover with waterproof covers.

C. Handle materials to prevent damage. Remove damaged materials and replace with new, undamaged materials.

1.7 PROJECT CONDITIONS

A. Substrate: Proceed with work after substrate construction, openings and penetrating work have been completed.

B. Weather: Proceed with waterproofing and associated work only when existing and forecasted weather conditions will permit work performance in accordance with manufacturer’s recommendations and warranty requirements for specific project requirements.

1.8 WARRANTY

A. Warranty eligibility for the project must be validated by Manufacturer, confirming acceptance of the installation and independent inspection reports are in accordance with the manufacturer's quality assurance program requirements.

B. Waterproofing Material and Labor Warranty: Upon installation completion and manufacturer acceptance of the work required by this section, the waterproofing materials manufacturer will provide to the project Owner, a written five (5) year non-prorated warranty, covering both materials and labor. Issuance of Manufacturer's Waterproofing Warranty requires the following:

1. Waterproofing System products and drainage composite products shall have been provided by a single manufacturer;

2. Installation of waterproofing products and prefabricated drainage composite by Manufacturer's Approved Applicator in full accordance with manufacturer's quality assurance program requirements;

3. Installation inspected by an approved and trained Independent Inspection Firm participating with the waterproofing manufacturer's Certified Inspection Program;

4. In Division 3 Section "Concrete Forming and Accessories," waterstop product of the same manufacturer as the products of this Section must be installed in all applicable concrete cold pour construction joints, including around applicable penetrations. Manufacturer's warranty shall be independent from any other warranties made by the Contractor under requirements of the Contract Documents and may run concurrent with the other warranties.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products Manufacturers:

1. Basis of Design: CETCO, 800/527-9948.

2. Tremco Commercial Sealants and Waterproofing, 800-852-9068.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 FOUNDATION WATERPROOFING MEMBRANES

A. BENTONITE WP 1, Under Slab: Cetco "Voltex DS."

1. Dual membrane composed of high density polyethylene (HDPE) laminated to bentonite.

2. Sodium bentonite encapsulated between a non-woven and woven geotextile.

3. Weight of Sodium Montmorillonite (Bentonite): Approximately 1.0 lb./s.f.

4. Thickness of HDPE: 15mils.

5. Approximate Thickness of Laminated Membrane: 200 mils, ±10 mils.

6. Grab Tensile Strength: 95 psi; ASTM D4632.

7. Puncture Resistance: 140 lbs.; ASTM D4833.

8. Color: Gray/Black.

B. BENTONITE WP 2, Foundation Walls: CETCO Voltex.

1. Sodium bentonite encapsulated between a non-woven and woven geotextile.

2. Weight of Sodium Montmorillonite (Bentonite): Approximately 1.0 lb./s.f.

3. Approximate Thickness of Laminated Membrane: 200 mils, ±10 mils.

4. Grab Tensile Strength: 95 psi; ASTM D4632.

5. Puncture Resistance: 100 lbs.; ASTM D4833.

6. Color: Gray/Black.

2.3 ACCESSORIES AND RELATED MATERIALS

A. MEMB WP 1, **Transition to Sheet Waterproofing or WRB**: CETCO “Envirosheet,” self-adhering sheet membrane waterproofing, 60-mil sheet consisting of 56-mils of rubberized asphalt and a 4-mil cross-laminated, polyethylene carrier film, with Enviropirmer WB water base substrate primer.

B. Joint Tape: CETCO “SeamTape," self-adhering tape; 2-inches wide. Color black.

C. Termination Bar: Aluminum alloy bar, factory-prepunched, designed for use as termination bar, edge protector or caulk bar.

D. Tape for Temporary Exposed Conditions: CETCO "SeamTape," adhesive coating on PVC coated fabric for use at membrane joints and terminations temporarily exposed to the elements during construction, prior to concealment or backfill.

E. BENTONITE SLNT, Mastic/Caulk: CETCO "Bentoseal," thick compound of expandable mastic/caulk for use at voids, honeycombs, penetrations, tie-backs, cants and similar conditions.

F. Granular Bentonite: CETCO "Waterstoppage," high quality, Wyoming type, sodium montmorillonite, similar to material used in membranes specified above, for use in forming coves and for filling voids during installation of systems.

G. JT PACKING: CETCO "Hydrobar Tubes," 2" (50 mm) diameter x 2' (60 cm) long, water soluble tube container filled with active granular sodium bentonite.

H. Thru-Wall Detailing: CETCO "GF-40SA," self-adhering flashing membrane used for grade and thru-wall detailing.

I. Base And Sheet Drainage Composite:

1. Aquadrain 15XP - 4-ft by 52-ft roll of a three-dimensional polypropylene drainage core with a nonwoven geotextile adhered to one side to allow water passage while restricting soil particles. Composite includes a thin polyethylene sheet on the back of the drainage core.

a. Compressive Strength, 15,000psf (718 kPa).

b. Water Flow Rate, 20gpm/ft (251 l/m/m).

c. Thickness, 7/16" (11 mm).

2. Aquadrain 100BD Base Drain – 1" (25 mm) thick x 12" (300 mm) high base drain composite designed to collect water from sheet composite drainage and then discharge the water to proper sump system or gravity to daylight.

a. Compressive Strength, 10,000psf (457 kPa).

b. Water Flow rate, 97gpm/ft (1,197 l/m/m).

c. Thickness, 1" (25 mm).

J. LIQUID FLASHING: CETCO "M-2000."

K. Sealants/ Detail Sealants: CETCO "CETSEAL."

L. Temporary Protection Under Floor Slab: 6 mil thick black polyethylene sheeting, conforming to National Bureau of Standards PS 17-69.

PART 3 EXECUTION

3.1 INSPECTION

A. General: Inspect surfaces to receive membrane systems. Ensure that voids greater than 3/8-inch are filled with mastic and that sharp projections are removed.

B. Do not install membranes or systems in standing water. Note temperature limitations for each product.

C. Vacuum or broom clean surfaces to receive tape, adhesive products or primers. Ensure that such surfaces are free of dust, dirt, snow, ice and other contaminants not compatible with applied products.

3.2 PREPARATION

A. Lay out project to determine anticipated conditions prior to start of work. Note termination and penetration conditions and determine preferred methods for creating waterproof envelope.

B. Form coves, 1-1/2-inches to 2-inches, with granular bentonite at intersections of walls and footings. Form coves with mastic at vertical inside corners, under ledges and at penetrations.

C. Immediately prior to application of tapes and waterstops, prime surfaces to properly prepare areas to receive waterstops or taped applications and terminations.

3.3 INSTALLATION OF WATERSTOP MATERIAL

A. Refer to Division 3 Section “Concrete Forming and Accessories.”

3.4 INSTALLATION UNDER FLOOR SLAB

A. Install membrane with woven geotextile side up, with edges overlapped 3-inches.

B. Protect bentonite membrane from damage caused by sharp edges or points of rebar chairs.

C. Staple joints 18-inches o.c. or often enough to prevent excessive movement.

D. Pour granular bentonite or trowel mastic/caulk around all penetrations and press in "cut to fit" collar of bentonite membrane.

E. Extend the installation of bentonite membrane 8-inches up or beyond the perimeter slab forms.

F. Inspect and repair damaged material before concrete pour.

G. Protect bentonite membrane exposed to high traffic or inclement weather with 6 mil polyethylene sheets. Remove polyethylene sheets prior to pouring the floor slab.

3.5 INSTALLATION AT FOUNDATION WATERPROOFING MEMBRANES

A. Membrane: Place membrane over prepared surfaces, vertically and horizontally as applicable for conditions as detailed, to ensure minimum handling of products. Fit materials closely and seal around inlets, outlets, and other penetrations and projections. Comply with installation procedures recommended by membrane manufacturer.

1. All blindside installations have bentonite side facing installer.

2. All face-of-wall installations have bentonite side facing wall.

B. Field Joints: Install membrane shingle fashion to prevent intrusion of water. Overlap a minimum of 1-1/2-inches typically, depending on installation conditions.

1. Vertical Seam Applications: Nail at 24-inches to 48-inches o.c. as recommended by manufacturer for conditions indicated. Tape seams with temporary tape.

2. Horizontal Seam Applications: Nail at 18-inches o.c., maximum.

C. Penetrations: Cut membrane to fit snugly at penetration. Form cove around penetration with specified mastic. Furnish and install site fabricated collar made from standard waterproofing membrane to fit tightly around penetration and press firmly to embed fully in mastic. Fasten collar and tape in place.

D. Termination: Fasten termination bar at top of membrane. At exposed grade line terminations, position to permit application of elastomeric sealant, specified in Division 7 Section "Joint Sealants." Space fasteners at 8-inches o.c. Confirm suitability of substrate to accept fasteners.

E. Install drainage panels over membrane in accordance with manufacturer’s printed instructions.

3.6 PROTECTION

A. Protect against flooding or other activation of bentonite membrane prior to completion of related work.

3.7 CLEANING

A. Clean areas and surfaces where work has been performed. Remove trash and debris resulting from the Work of this Section.

END OF SECTION

THERMAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services required for the installation of thermal insulation in wall areas as detailed.

B. **Related Section: Division 31 Section "Excavation and Fill."**

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1.3 ADDITIONAL REQUIREMENTS

A. Listed R-values are for insulation only and represent minimum acceptable values.

1.4 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product data for each type of insulation product specified.

C. Product test reports from and based on tests performed by a qualified independent testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.

D. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence compliance of foam-plastic insulations with building code in effect for Project.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E84.

2. Fire-Resistance Ratings: ASTM E119.

3. Combustion Characteristics: ASTM E136.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to project site in manufacturer's original packaging, indicating R-value, type of material and other pertinent data.

B. Store all materials off the ground, protected from weather and traffic damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed below.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Batt Insulation:

1. Friction fit, un-faced, formaldehyde-free fiberglass batt insulation containing at least 25% post-consumer or 50% post-industrial recycled glass in exposed installations such as plenum areas and where covered by wall or ceiling finish. Comply with local code, Class I flame-spread rating of 15 to 25 as tested per ASTM E84, and with ASTM C665, Type I.

2. Schedule:

a. Plenums: R-19.

b. Walls: R-13 in wall cavities up to 4-inches deep; R-19 in wall cavities from 4-1/2-inches to 8-inches deep.

B. Polyethylene Vapor Barrier: ASTM E96, 2 mils thick, with variable permeance rating of less than 1 to greater than 10 perms.

1. Manufacturer: Certainteed Corp. "MemBrain."

C. Rigid Insulation:

1. External Wall Cavity Mineral Wool Board: Thickness as detailed, 4.5 lb/cu ft, R-value of 4.3/inch, exterior wall insulation. Non-combustible stone wool insulation with melting point of approximately 1177°C (2150°F).

a. Manufacturers:

(1) Roxul "CavityRock DD" thickness: 4-inches.

2. **INSUL 1B, Perimeter Foundation Insulation:**

   a. **Extruded polystyrene insulation board, R-7.5. 1-1/2-inch minimum thickness.**

   b. **Conform to ASTM C578, Type IV. Minimum compressive strength 25 psi., R-5 per inch thickness.**

   c. **Manufacturer: Dow "Squaredege."**

D. Anchors, Spindle-Type, Adhesively Attached:

1. Plate welded to projecting spindle; capable of holding insulation, of thickness indicated, securely in position with self-locking washer in place.

   a. Plate: Perforated galvanized low carbon steel sheet, 0.106-inch thick x 2-inches square.

   b. Spindle: Copper-coated or galvanized low carbon steel, fully annealed, 0.105-inch in diameter (12 gauge).

   c. Washers: Galvanized steel, 1-1/2-inch diameter self-locking.

2. Manufacturers:

   a. AGM Industries "TACTOO Insul-Hangers" and “RC 150 Round Self-Locking Washers.”

   b. Gemco “Insulation Hangers,” spindle type hangers and “R-150 Round Self-Locking Washers.”

E. Spindle Adhesive:

1. Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

2. Manufacturers:

   a. AGM Industries "TACTOO GPA-72 Adhesive,” 404.5 g/l VOC.

   b. Gemco "Tuff Bond Hanger Adhesive," 404.5 g/l VOC.

F. Foundation Insulation Adhesive: Dow "Great Stuff Pro Wall and Floor Adhesive."

G. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

H. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

I. Insulating-Foam Sealant: Dow Chemical Great Stuff Window and Door Insulating Foam Sealant. Low-pressure, polyurethane window and door insulating-foam sealant.

PART 3 EXECUTION

3.1 PREPARATION

A. Examine areas scheduled to receive insulation to ensure protection against weather and other hazards, inspect space allocated for proper depth to receive specified material. Do not install wet insulation.

3.2 INSTALLATION

A. Install insulation as detailed and as required to create a fully enclosed "insulation envelope."

B. Fit batt insulation snugly between framing members.

C. Install rigid insulation to wall areas with mastic adhesive as recommended by the manufacturer or with spindle type anchors at approximately 2-foot to 3-foot centers. Fit insulation tight between furring members.

D. Insulate small areas between closely spaced framing members. Cut and fit around pipes, conduits and outlet boxes. Where pipes are located in stud spaces, place insulation between exterior wall and pipe, compressing insulation if necessary.

E. Place interior foam seal around window and door perimeters to maintain continuity of building thermal and air barrier using insulating-foam sealant.

F. **Foam-Plastic Board Insulation Under Concrete: Install rigid insulation as detailed and secure in-place as recommended by insulation manufacturer to prevent movement during concrete placement. Tape joints, factory edges and cut edges.**

3.3 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates.

B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.

C. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16-inches o.c.

D. Seal penetrations caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.4 CLEANING

A. Remove debris, leaving areas in a clean, uncluttered condition.

END OF SECTION

PHENOLIC WALL PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, and equipment required for the installation of exterior solid phenolic cladding panel system and accessories as required for a complete drained and back-ventilated rainscreen system.

B. Related Sections:

1. Division 5 Section “Metal support for cladding.”

2. Division 7 Sections “Thermal Insulation” and “Weather Resistant Barrier.”

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

2. ASTM D 635 - Standard Test Method for Small Scale Burning.

3. ASTM D 1929 - Standard Test Method for Ignition Temperature.

4. ASTM D 2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.

5. ASTM D 2247 - Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.

6. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

7. ASTM E 119 - Standard Test Method for Fire Rated or Fire Resistive Construction.

8. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the Influence of Wind Loads.

B. International Organization for Standardization (ISO):

1. ISO 105 A02-93 - Tests for Color Fastness -- Part A02: Grey scale for assessing change in color.

2. ISO 178 - Determination of Flexural Properties.

3. ISO 527-3 - Determination of Tensile Properties.

4. ISO 846 - Evaluation of the Action of Organisms.

C. National Fire Protection Association (NFPA):

1. NFPA 268 - Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source.

2. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "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: Submit plan, section, elevation and perspective drawings necessary to describe and convey the layout, profiles and product components, including edge conditions, panel joints, fixture location, anchorage, accessories, finish colors, patterns and textures.

D. Code Compliance: Documents showing product compliance with local building code shall be submitted prior to the bid. These documents shall include, but not be limited to, appropriate Evaluation Reports and/or test reports supporting the use of the product. Alternate materials must be approved by the Architect of record prior to the bid date.

E. Engineering Calculations: Submit engineering calculations as required by the local building code, showing that the installed panels and attachments system meets the wind load requirements for the project.

F. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns. Please note that samples are only representative for color and pattern and not for thickness or edge finish. Metallic colors may also show a slight fluctuation in appearance do to the metal flake orientation from batch to batch.

G. Verification Samples: For each finish product specified, two samples a minimum of 3.5 inches by 3.5 inches (89 mm by 89 mm) representing actual product, color, and patterns. Sample edges may vary from field panel edges.

H. Maintenance Data: Submit maintenance and cleaning information for products covered under this section.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary panel products specified in this section shall be supplied by a single manufacturer with a minimum of ten years experience.

1. Products covered under the Work listed in this Section shall be manufactured in an ISO 9001 certified facility.

B. Installer Qualifications: All products listed in this section shall be installed by a single installer trained and approved by the manufacturer or manufacturer’s representative. Warranty only available when material is installed by an installation contractor trained and approved by the manufacturer's representative.

C. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

D. Mock-Up: Provide a mock-up in size and location as required by the Architect, for evaluation of the product and application workmanship.

1. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

E. Pre-installation Meetings: Conduct pre-installation conference to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. During transportation, use stable, flat pallets that are at least the same dimension as the sheets.

2. Materials shall be packaged to minimize or eliminate the possibility of damage during shipping. Items such as wooden side boards, wooden lid, and spacers or protective sheeting between panels shall be used to protect the panels from surface and/or edge damage.

B. Storage:

1. Store products in an enclosed area protected from direct sunlight, moisture and heat. Maintain a consistent temperature and humidity.

2. Store products in manufacturer's unopened packaging until ready for installation.

3. Stack panels using protective dividers to avoid damage to decorative surface.

4. For horizontal storage, store sheets on pallets of equal or greater size as the sheets with a protective layer between the pallet and sheet and on top of the uppermost sheet.

5. Do not store sheets, or fabricated panels vertically.

C. Handling:

1. Remove protective film within 24 hours of the panels being removed from the pallet.

2. When moving sheets, lift evenly to avoid dragging panels across each other and scratching the decorative surface.

3. Remove all labels and stickers immediately after installation.

1.6 PROJECT 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.

B. Field Measurements: Verify actual measurements/openings by field measurements performed by the installer prior to release for fabrication. Recorded measurements to be indicated on shop drawings based on field measurements provided by the installer. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.7 WARRANTY

A. Warranty: At Substantial Completion, provide manufacturer's limited ten year warranty covering defects in materials.

B. Installer Qualifications: All products listed in this section shall be installed by a single installer trained and approved by the manufacturer or manufacturer’s representative. Warranty only available when material is installed by an installation contractor trained and approved by the manufacturer's representative.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Trespa International B.V.; P.O. Box 110, 6000 AC Weert Wetering 20, 6002 SM Weert The Netherlands; www.trespa.com.

B. Acceptable Manufacturer's Representative: Trespa North America, Ltd.; 800-487-3772, Web: http://www.trespa.com/na.

C. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 WALL PANELS

A. Solid Phenolic Wall Panels: Trespa Meteon by Trespa International as represented by Trespa North America, LTD.

1. Material: Solid panel manufactured using a combination of high pressure and temperature to create a flat panel created from thermosetting resins, homogenously reinforced with wood-based fibers and an integrated decorative surface or printed décor.

2. Color on Primary Face: Wood Décor - Halmstad color with black reverse.

3. Finish: Rock (matt).

4. Panel Core: Fire retardant (FR) black core.

5. Panel Thickness: As indicated on the Drawings.

6. Physical Properties:

a. Modulus of Elasticity: 1,300,000 psi (9000 N/mm2) minimum, ISO 178.

b. Tensile Strength: 10,100 psi (70 N/mm2) minimum, ISO 527-2.

c. Flexural Strength: 14,500psi (120 N/mm2) minimum, ISO 178.

d. Thermal Conductivity: 2.1 BTU/inch/ft2.hr.°F, EN 12524.

e. Structural Performance (ASTM E330):

(1) Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 15 pounds per square foot (psf). Wind load testing shall be done in accordance with this standard to obtain the following results:

(a) Normal to the plane of the wall, the maximum panel deflection shall not exceed L/175.

(b) Normal to the plane of the wall between supports, deflection of the aluminum sub-framing members shall not exceed L/175 or 3/4 inch, whichever is less.

1) At 1-1/2 times design pressure, permanent deflection of framing members shall not exceed L/100 of span length and components shall not experience failure or gross permanent distortion.

2) If system tests are not available, mock ups shall be constructed and tests performed under the direction of an independent third party laboratory which show compliance to the minimum standards listed above.

7. Fire Performance:

   a. Flame Spread: Class A, ASTM E 84.

   b. Smoke Development: Less than 450, ASTM E 84.

   c. Ignition Temperature: Greater than 650 degree F (350 degree C) above ambient, ASTM D1929.

   d. Burning Classification: CC1 or CC2, ASTM D635.

   e. When required for compliance with local building codes, the wall cladding assembly shall show no degradation of the rating of Fire Resistant Assemblies, ASTM E119.

   f. When required for compliance with local building codes, the wall cladding assembly including cladding and non-cladding elements such as, but not limited to, specific weather resistive barriers and/or exterior insulation materials, shall meet the performance requirements of NFPA 285. Performance shall be determined by actual testing in accordance with NFPA 285 or through an equivalency analysis provided by a recognized fire protection expert.

   g. When required for compliance with local building codes, the wall cladding assembly shall not ignite when exposed to a radiant heat energy source, NFPA 268.

8. Finish Performance: Electron Beam Cure resin in conformance with the following general requirements:

   a. Color: Wood Décor – Halmstad.

   b. Humidity Resistance: No formation of blisters when subjected to condensing water fog at 100% relative humidity and 100 degree F (38 degree C) for 3000 hours, ASTM D 2247.

   c. Salt Spray Resistance: Corrosion creepage from scribe line (1/16 inch (1.6 mm) max.) and minimum blister rating of 8 within the test specimen field, ASTM B117.

   d. Weather Exposure: Accelerated - 3000 hours in Atlas Type Weatherometer using cycle of 90 minutes light and 30 minutes diminished light and demineralized water with a maximum color change of 5 Delta E units from the original color according to ASTM D-2244, with the exception of Uni-Colors A12.3.7 / A18.3.5 / A04.1.7, which will not deviate more than 10 Delta E units from original color according ASTM D-2244.

   e. Color Stability: The decorative surface comply with, classification, 4 - 5 measured with the grey scale according to ISO 105 A02-93 according to test method EN 438-2:29.

f. Microbial Characteristics: Will not support micro-organic growth (ISO 846).

B. Mounting System:

1. **TS110 - Exposed fastening on fixed depth aluminum sub-framing.**

2. **TS120 - Exposed fastening on variable depth aluminum sub-framing.**

3. **TS210 - Concealed fastening over fixed depth aluminum sub-framing.**

4. **TS220 - Concealed fastening over variable depth aluminum sub-framing.**

5. **TS110-285 - Exposed fastening on fixed depth aluminum sub-framing tested and meeting the performance requirements of NFPA 285.**

6. **TS120-285 - Exposed fastening on variable depth aluminum sub-framing tested and meeting the performance requirements of NFPA 285.**

7. **TS210-285 - Concealed fastening over fixed depth aluminum sub-framing tested and meeting the performance requirements of NFPA 285.**

8. **TS220-285 - Concealed fastening over variable depth aluminum sub-framing tested and meeting the performance requirements of NFPA 285.**

9. **Other installation systems - Include test documentation showing compliance with the performance criteria set forth in the specification and in accordance with the local building code.**

C. Aluminum Sub Structure: Aluminum sub-structure designed to withstand structural loading due to wind load and the dead load of the panel, painted as required to conceal behind the open joinery of the attachment system.

1. Extrusions, including corner closures, joint closures and vent screens, formed members, sheet, and plate shall conform to the recommendations of the manufacturer.

D. Extruded Aluminum Trim: Color as Selected by Architect.

E. Fasteners (Concealed/Exposed): Fasteners shall be non-corrosive and as recommended by panel manufacturer. Exposed fasteners shall be colored to match panels where required by the architect.

F. Panel Corner Profile:

1. **Dimensions: 143.70 inches by 11.81 inches by 11.81 inches (3650 by 300 by 300 mm) with a 5/16 inch (8 mm) thick by ¾ inch (19 mm) radius.**

2. **Dimensions: 143.70 inches by 11.81 inches by 11.81 inches (3650 by 300 by 300 mm) with a 3/8 inch (10 mm) thick by ¾ inch (19 mm) radius.**

2.3 FABRICATION

A. Panels: Solid phenolic impregnated kraft paper wall panels with no voids, air spaces or foamed insulation in the core material. Accessory items in accordance with manufacturer's recommendations and approved submittals.

B. Panel Weight: **8 mm (2.4 lb/ft2), 10 mm (3 lb/ ft2), 13 mm (3.8 lb/ ft2).**

C. Panel Bow: = 2 mm / m (= 0.079 inch/39.38 inches).

D. Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.

E. Appearance: Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Surfaces to receive panels shall be even, smooth, dry, and free from defects detrimental to the installation of the panel system. Notify Contractor in writing of conditions detrimental to proper and timely completion of the work.

C. Confirm exterior sheathing is plumb and level, with no deflection greater than 1/4 inch (6 mm) in 20 feet (6096 mm).

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding. Do not proceed with installation until unsatisfactory conditions have been corrected.

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 solid phenolic wall panels and sub-frame system in accordance with manufacturer's instructions.

B. Install solid phenolic wall panels plumb and level and accurately spaced in accordance with manufacturer's recommendations and approved submittals and drawings.

C. Anchor panels and sub-framing securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary movement and structural support.

D. Fasten solid phenolic wall panels with fasteners approved for use with supporting substrate.

E. Do not install panels or component parts which are observed to be defective or damaged including, but not limited to: warped, bowed, abraded, scratched, and broken members.

F. Do not cut or trim component parts during installation in a manner that would damage the finish, decrease the strength, or result in visual imperfection or a failure in performance. Return component parts with require alteration to the shop for re-fabrication or replacement.

G. Install corner profiles and trim with fasteners appropriate for use with adjoining construction as indicated on the Contract Drawings and as recommended by manufacturer.

3.4 ADJUSTING AND CLEANING

A. Remove masking or panel protection as soon as possible after installation. Any masking intentionally left in place after panel installation on an elevation, shall become the responsibility of the Contractor to remove.

B. Adjust final panel installation so that all joints are true and even throughout the installation. Panels out of plane shall be adjusted with the surrounding panels to minimize any imperfection.

C. Repair panels with minor damage. Remove and replace panels damaged beyond repair as a direct result of the panel installation.

D. Clean finished surfaces as recommended by panel manufacturer.

END OF SECTION

TPO SINGLE PLY MEMBRANE ROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for and incidental to the application of thermoplastic polyolefin (TPO) single ply membrane roofing materials necessary for a complete weathertight installation.

B. Related Section:

1. Division 6 Section "Rough Carpentry" for installation of wood insulation stops.

2. Division 7 Section "Flashing and Sheet Metal" for application and securing of metal counterflashings, coping and other weatherproofing work.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. Factory Mutual Engineering and Research (FM).

C. Federal Testing Material Standard (FTMS).

D. International Code Council (ICC).

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7 and code required wind criteria for the Project’s wind exposure classification.

D. Regulatory Requirements: Roof system shall meet requirements of UL Class A Roof System.

1.4 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Submit a Pre-Job Survey form to the roof membrane manufacturer's technical department for approval prior to the job start. This enables the technical department to approve the intended assembly and assign a job number to the project. This submittal may include deviation request forms or pullout test results, depending on the project criteria.

C. Shop Drawings:

1. Shop drawings prepared by the authorized roofing applicator, and approved and assigned a number by the manufacturer.

2. Shop drawings shall include:

a. Outline of roof and size (square footage).

b. Deck type.

c. Roof slope and designated direction of slope.

d. Location and type of all penetrations.

e. Location of walking pads.

f. Perimeter and penetration details.

g. Sheet layout and sizes.

3. When field conditions necessitate modifications to the originally approved shop drawings, a copy of the shop drawing outlining all modifications must be submitted to the membrane manufacturer for revision and approval prior to submitting to Architect for review.

4. Submit final shop drawings to membrane manufacturer prior to inspection and warranty issuance.

D. Product Data:

1. Roof System: Copies of most recently published properly identified product data for TPO single ply membrane roofing, accessory components, and published installation instructions.

2. Insulation manufacturer, brand, thickness, and product data.

3. Fastener manufacturer, brand and length.

E. Warranty type and period.

F. Certification:

1. Submit certification that membrane applicator is approved by membrane manufacturer for application of warranted membrane.

2. Submit membrane manufacturer's certification that membrane is recycleable.

G. Manufacturer's current roofing brochure.

H. One 3-inch x 6-inch sample of roofing membrane.

I. Testing or proof of resistance to chemicals or materials that may deteriorate the membrane.

J. Certificate of manufacturer's warranty and installer's guarantee.

K. Proof of successfully passing EPA TCLP testing. Submit tested evidence that membrane shall be acid/base neutral and shall not release heavy metals or other hazardous materials into surface run-off.

L. Refer to Part 2 of this Section for additional submittal requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in mechanically attached, reinforced, TPO membranes with ten years experience. The manufacturer shall certify the scrim reinforced TPO membrane meets the physical properties specified.

B. Applicator: Company approved by membrane manufacturer and specializing in single ply roofing systems with at least four installations of mechanically attached, scrim reinforced TPO roofing within the past two years.

C. Inspection:

1. As soon as all Work under this Section has been completed, the roofing installer shall notify the manufacturer of completion of Work, and the roofing manufacturer's representative shall make an inspection of the roofing system. A punch list of all items failing to meet the manufacturer's requirements shall be forwarded to the roofing installer and Architect. Correction of the punch list items shall be completed within 14 days at which time the roofing installer shall be given written notification to the manufacturer that the installation meets with the manufacturer's warranty requirements.

2. A pre-warranty inspection by the membrane manufacturer and Owner in the presence of the Architect shall be performed to determine that the Work is acceptable, complete, and ready for issuance of appropriate warranty. However, the warranty will not be issued until Substantial Completion, when the membrane will be reinspected by the membrane manufacturer, Owner and Architect. Damaged membrane shall be repaired prior to issuing the warranty.

D. Changes or deviations from this Specification shall be approved in writing by the manufacturer and be acceptable to the Owner.

E. Pre-Roofing Meeting:

1. Schedule and administer Pre-Roofing Meeting to review single ply roofing system products, application, compatibility, scheduling, interface coordination, warranty/ guarantee and quality standards, with attending Architect, roofing applicator's representative, job superintendent, manufacturer's representative, subcontractors, and suppliers for the work of this Section, Division 6 Section "Rough Carpentry," and Division 7 Section "Flashing and Sheet Metal." Record and distribute minutes of the Pre-Roofing Meeting to attendees and others responsible for related work listed herein. Satisfactory adoption of the minutes of the Pre-Roofing Meeting minutes by all will be automatic when no written amendments to the minutes are received within fourteen days after the Pre-Roofing Meeting.

2. Membrane manufacturer will provide technical assistance for Pre-Roofing Meeting and initial start-up of the work.

F. Product Compatibility: Provide products which are components of a single manufacturer, or are certified by the membrane manufacturer as compatible.

G. Manufacturer's Requirements: Where any provision or requirement of product installation called for in these Specifications is in conflict with the membrane manufacturer's printed installation procedures, the manufacturer's instructions shall prevail.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store materials in original unopened containers with manufacturer's identification and installation instructions.

B. Materials, except membrane, to be stored at ambient temperature of 60°F to 80°F. If stored at lower temperature, restore to proper temperature prior to using.

C. Store all materials, including membrane, in a dry, protected area. Damaged materials must not be used. Installed materials found to be damaged shall be replaced at contractor's expense.

D. Protect the membrane from abuse or damage during storage.

1.7 PROJECT CONDITIONS

A. Weather Protection: Protect roofing material at all times from wetting and moisture absorption. Store rolls on end in a dry area, protected from ground moisture and covered at all times with waterproof covering. Remove improperly stored and moisture damaged material from the premises. Phase the work to complete roofing assembly in each area without interruption when practical. Install only the amount of insulation that can be covered during the same day.

B. Site Conditions:

1. Roof deck shall be dry and free from ponded water, frost, or other moisture source prior to start of roofing system.

2. Protect roofing system from petroleum, grease, oil, solvents, vegetable and mineral oil, animal fat, or direct steam venting.

3. Do not expose membrane and accessories to a constant temperature in excess of 180°F.

4. All splicing and bonding surfaces shall be kept dry and clean.

1.8 WARRANTY

A. Contractor's Warranty Agreement:

1. Provide a written notarized warranty cosigned by the Contractor and roofing installer covering both roofing and sheet metal for a period of two years from Substantial Completion, warranting that all surfaces exposed to the weather are watertight and free from defective materials and deficiencies in workmanship, and that any portion of this work which fails in the performance of its purpose will be repaired or replaced at no cost to the Owner.

2. Emergency leaks will be attended to within 24 hours from receipt of notice from Owner. As soon as weather permits, Contractor will restore affected areas to standards of this contract without voiding the manufacturer's warranty and repair any damages from these leaks without cost to Owner, except for leaks caused by abuse to roof by others or by abnormal weather conditions such as lightning, severe hail, or other unusual climatic phenomena.

B. Manufacturer's Warranty:

1. Submit to the Architect a manufacturer's total system unlimited penal sum warranty covering all repairs and replacements to keep the roof (including the field and flashing) watertight for period of 30 years beginning at Substantial Completion.

2. The warranty shall be from the manufacturer of the membrane, not the marketer. No rebranded products shall be accepted.

3. The warranty shall include the plates and fasteners of the fastening systems, the insulation and the termination bars.

4. The warranty shall contain no exclusion for damage caused by wind. Wind speed limitation under warranty shall not be any less than that calculated by code required wind criteria for the Project's wind exposure classification, but not more than 72 mph.

5. The warranty shall contain no exclusion or limitation for improper installation, or damage from environmental contaminants, or damage from water that ponds, or does not drain freely.

6. The warranty shall be executed by manufacturer to cover any and all costs for repairs necessary to stop leaks which occur resultant of, but not limited to, the following:

a. Deterioration of the roofing membrane or base flashing system resulting from ordinary wear and tear by the elements.

b. Workmanship on the part of the roofing contractor in application of the roofing membrane or base flashing system.

c. Splits or cracks in the roofing membrane not caused by structural movement.

d. Slippage of the roofing membrane or base flashing.

e. Delamination of membrane seams.

7. If after 24 hours notification of roof leakage, manufacturer has not responded, Owner shall have the right, without invalidating his warranty and at the expense of the manufacturer, to make any emergency temporary repairs that are required in order to protect the building and its contents from damage due to roof leakage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Mechanically Attached, reinforced, TPO single ply membrane manufacturers: Genflex TPO," 800-443-4272.

B. Other Approved Manufacturers: Subject to compliance to requirements of this specification, equal products by the following manufacturers are approved:

1. Carlisle, 877-409-2706.

2. Johns Manville, 800-654-3103.

3. Firestone, 17-579-7000.

C. Other Products: Manufacturers are listed below.

D. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

E. Additional submittal requirements for Substitution Requests are:

1. Complete specification with details for Architect’s review, along with certification from Manufacturer of substitute membrane that proposed material and system is in compliance with all other requirements of this specification. Submit data as detailed in Part 1, above.

2. List of completed projects similar in location and magnitude to this project.

3. Proof of at least ten years experience as manufacturer of reinforced TPO roofing membrane.

4. Proof of meeting or exceeding the physical properties specified.

5. Verification of UL Class A with a minimum 6-foot wide membrane attachment, in order to minimize seams on the roof. Every roll of membrane shall be UL labeled.

6. Proof that membrane and insulation fasteners pass 45 cycles of Kesternich testing with a maximum of 5% red rust.

7. Provide adequate background information to the Architect, to demonstrate that manufacturer has the capability to service, and back the warranty for the term herein specified.

8. Manufacturer shall submit data regarding intended installing contractors demonstrating that they shall have been an authorized contractor of the intended roof system for at least two years prior to bid date and shall have completed at least four warranted, 20,000 s.f., non-residential projects with the intended roofing system in the last two years.

2.2 MATERIAL

A. Elastomeric Sheet Material: Single ply membrane shall be 60 mil overall thickness, white TPO membrane reinforced with a polyester 10 x 10, 1000D scrim encapsulated in one pass through the calendar. There shall be more than 20 mils of TPO membrane between the scrim and the weathering surface of the roof. The TPO sheet physical properties must be actual tested properties of the sheet, not typical or hypothetical values. In order to minimize seams on the roof, the minimum width of the membrane shall be 6-feet-4-1/2-inches except for 1/2 width sheets at roof perimeter. The membrane shall have the following physical properties:

Physical Property	Test Method	Specification
1. Weight	ASTM D751	0.29 lbs/s.f.
2. Breaking Strength, min.	ASTM D751	330 lbs.
3. Tear Strength, min.	ASTM D751	156 lbs. MD
4. Low Temperature Bend	ASTM D2137 -49°/1/8-inch mandrel	Pass
5. Heat Aging	ASTM D573/ASTM D751	Maintains 90% of original strength at breaking and elongation at reinforcement, 60% at tearing strength
6. Solar Reflectance, white	ASTM C1549	77%

7.	Thermal Emittance	ASTM C1371	0.87%
8.	Hydrostatic Resistance	ASTM D471 7 days	+/- 3%
9.	Ozone Resistance Test Performed on Unreinforced Material Only	ASTM D1149 3 ppm (@ 30% strain @ 104°F (40°C): 72 and 2500 hrs.	Pass
10.	Puncture Resistance	ASTM D5602 Static ASTM D5635 Dynamic	33 lbs. minimum 20 Joules
11.	Elongation at Reinforcement Break, min.	ASTM D751	30%

B. Mechanically Attached System: Provide membrane manufacturer's standard system of plates and fasteners for attachment of the membrane to substrate at sheet perimeter and at intermediate locations to meet requirements for wind uplift warranty.

2.3 RELATED MATERIALS

A. Flashing: Same membrane as roofing. For field-fabricated vent stacks, pipes and corners provide unreinforced 55 mil thick white TPO.

B. Bonding Adhesive: Genflex Membrane Adhesive for bonding membrane to substrate.

C. All Purpose Sealant: "Genflex Multi-Purpose Sealant" to serve as a water cut-off mastic, pitch-box sealer, and to caulk membrane edge to metal.

D. Cleaning Solvent: "GenFlex Membrane Cleaner" for cleaning membrane as required prior to seam sealing.

E. Seam Caulk: "GenFlex Edge Sealant" shall be provided for the purpose of sealing any nonencapsulated edge of reinforced membrane.

F. Overnight Seal: As provided by membrane manufacturer.

G. Sealants: Sealants not a part of the membrane manufacturer's system shall be compatible with the membrane materials, approved by membrane manufacturer, and applied according to sealant manufacturer's instructions. Acceptable sealants are one part polysulfide and one part urethane. They shall be free of pitch extenders, exterior grade, suitable for horizontal or vertical applications according to their usage, and shall be recommended by sealant manufacturer for the particular usage. Silicone sealants are not acceptable.

H. Mechanical Fasteners:

1. Steel and Wood Deck:

a. Insulation Fasteners: GenFast #12 (preassembled insulation fastener).

b. Membrane Fasteners: GenFast #15 (assembled screw and plate).

c. Where 1-1/4-inch plywood decking occurs, the underside is the finished ceiling, therefore fasteners shall be sized to prevent deck penetration.

I. Slip Sheet: Atlas FR 50 mineral glass felt mat, 0.188 lbs./s.f.

J. Vapor Barrier: W.R. Grace “Grace Select,” self-adhering 25-mil sheet of SBS modified asphalt and high density cross laminated polyethylene.

1. Vapor Barrier Primer: W.R. Grace “Perm-A-Barrier WB Primer.”

K. Roof Walkways: Provide walkways over membrane as detailed and where required for regular traffic to service rooftop units. Walkway may consist of laminated TPO walk boards adhered to the membrane with "GenFast Bonding Adhesive."

L. Polyisocyanurate Insulation:

1. Rigid polyisocyanurate, CFC, HCFC free, LTTR 30 (Long Term Thermal Resistance), integrally laminated to heavy non-asphaltic fiber-reinforced felt facers, and shall be satisfactory to and approved by roofing manufacturer for installation with roofing membrane when installed in strict accordance with approved shop drawings and limitations set forth in insulation manufacturer’s published literature. Provide crickets and tapered insulation where detailed.

2. Manufacturing Standards:

a. Standard Specification ASTM C1289-01, Type II, Class 1, Grade 2.

b. Density: ASTM D1622, Nom. 2 pcf.

c. Compressive Strength: ASTM D1621, 20 psi.

d. Dimensional Stability: ASTM D2126, 2% max., 7 days.

e. Moisture Vapor Transmission: ASTM E96, <1.5 perm.

f. Water Absorption: ASTM C209, <1.0% volume.

3. Testing Standards:

a. Windstorm Classification: FM 4450/4470, Class 1.

b. External Flame: UL 790 (ASTM E108) Class A.

c. Internal Flame: UL 1256, Class A.

d. Long Term Thermal Resistance (LTTR): CAN/ ULC S770 and ASTM C1303-95.

4. Manufacturers: Provided by and warranted by membrane manufacturer.

M. Rigid Base Board: G-P Gypsum Corporation "Dens-Deck Roof Board", Type X fire retardant, moisture resistant, UL Class A, FM Class 1, 1/2-inch thick, 48-inches wide, 96-inches long.

N. Cover Board: G-P Gypsum Corporation "Dens-Deck Prime Roof Board", moisture resistant, 1/2-inch thick, 48-inches wide, 96-inches long.

2.4 SUMMARY OF MATERIALS

A. System Type 1: Single ply membrane over insulated wood deck.

1. Vapor barrier.

2. Rigid insulation.

3. Cover board.

4. Slip sheet.

5. Single ply membrane.

B. System Type 2: Single ply membrane over insulated metal deck.

1. Rigid base board.

2. Vapor barrier.

3. Rigid insulation.

4. Cover board.

5. Slip sheet.

6. Single ply membrane.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine substrate and conditions under which roofing work is to be performed and correct unsatisfactory conditions. Do not proceed with roofing work until unsatisfactory conditions have been corrected in manner acceptable to installer and manufacturer. In all cases, substrate shall be smooth and free of debris, sharp edges and other surface irregularities prior to the start of work. Start of work constitutes acceptance of substrate.

1. During installation, membrane manufacturer shall be contacted for verification of conditions not previously identified.

3.2 PREPARATION OF SUBSTRATE

A. Substrate shall be dry, clean, smooth, free of sharp edges, and suitable for acceptance of membrane. Cover rough surfaces that would cause damage to the membrane with a protection board. Fill or repair joints greater than 1/4-inch wide. Plates and screws must be used to anchor membrane to roof deck.

1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.

2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that surface plane fastness and fastenings of steel roof deck complies with requirements in Division 5 Section "Metal Decking."

4. Wood nailers shall be installed at gravel stops or drip edges on outside perimeter of buildings. Anchor nailers to resist a force of 200 lbs./l.f. in any direction. Nailers are not required around skylights, curbs and expansion joints if they are mounted directly to the structural deck.

3.3 INSTALLATION

A. General: Comply with manufacturer’s written instructions for installation of the single ply membrane. Comply with all applicable codes.

B. Rigid Base Board on Metal Deck: Lay boards in moderate contact without forcing joints.

C. Vapor Barrier Membrane: Cover entire roof deck over to and including top of wall construction, closing vapor barrier at wall weather resistant barrier by overlapping weather resistant barrier where applicable.

D. Insulation and Cover Board: Mechanically fastened in accordance with board manufacturer’s requirements to meet membrane manufacturer’s requirements for wind criteria warranty. Install a minimum of 8 fasteners per 4-feet x 8-feet.

1. Attachment:

a. Insulation must be recommended by its manufacturer for mechanical attachment. All boards must be mechanically attached by a membrane manufacturer-approved plate and fastener. Membrane manufacturer’s minimum fastening requirements are:

(1) Two fasteners for insulation boards having any one dimension no greater than 4-feet.

(2) Four fasteners for insulation boards having any one dimension greater than 4-feet.

b. All fasteners are to be a minimum of 6-inches from both edges of the board. Irregular surfaces shall require additional fasteners. Boards shall conform to deck surface. Should the insulation manufacturer's fastening requirements exceed those of the membrane manufacturer, the more stringent requirements shall be followed.

2. Install tapered insulation to achieve positive slope throughout roof in accordance with roofing manufacturer's recommendations.

3. Place approved insulation with its longest dimension perpendicular to the direction of the membrane seams, with joints staggered. Place insulation uniformly, allowance for expansion/contraction with a 1/8-inch joint gap recommended, but close voids over 1/4-inch. Place cover board over insulation, with joints staggered. Mechanically attach as specified by the manufacturer.

E. Membrane Installation:

1. Use 6-foot wide minimum sheets to minimize seams. Accommodate contours of roof deck to drain across shingled laps of sheets. Do not stretch membrane prior to attachment.

2. Install membrane by unrolling over prepared substrate, fastening at laps, perimeter and at penetrations. Lap adjoining sheets a minimum of 4-1/2-inches and heat seal as recommended by the manufacturer. Seal all non-encapsulated edges with seam caulk.

3. Mechanically Attached Membrane:

a. Attach membrane with fasteners and plates into roof deck, following manufacturer's instructions for installation and spacing.

b. Perimeter half sheets: Install two at all exterior roof perimeters that are not bordered by a parapet wall or an adjoining building that is a minimum of 24-inches higher than roof level. Lay out in an approved pattern as detailed. Install plates and screws or anchors along the leading edge of the membrane through the insulation into the roof deck. See manufacturer's standard details for fastener spacing location. At perimeters that are to receive metal edging, continue the membrane over the outside edge and terminate 12-inches o.c.

F. Flashing: Flash perimeter, curb, vents, expansion joints, drains, and other details in compliance with manufacturer's standard published details. Exercise care to minimize possibility of damage to membrane.

1. Apply bonding adhesive to both underside of flashing and surface to which it is to be bonded at a rate of approximately one gallon per 60 s.f. of flashing.

2. Bonding adhesive shall not be applied to that portion of the flashing that overlaps onto itself. Hot air welding shall be used throughout the system where membrane overlaps itself.

3. Allow bonding adhesive to dry to finger touch where it does not string or stick to a dry finger, then roll the flashing into the dry adhesive. Exercise care to assure that the flashing does not bridge where there is any change of direction.

4. Mechanically fasten flashing 12-inches o.c. under appropriate counter flashing with approved fasteners for substrate, in accordance with manufacturer's details.

5. Install pipe flashings, expansion joints and roof drains in accordance with manufacturer's standard details.

G. Check and repair seams at the completion of work each day.

H. Temporarily seal loose edge of membrane with approved overnight seal at the end of each day to comply with manufacturer's instructions.

I. Walkway Protection: Install specified walkway protection at roof access areas and around roof mounted equipment. Place walkway protection carefully to avoid damage to membrane.

J. Inspect roofing and repair of bonding defects, raised or exposed fasteners, loose flashings, or other deficiencies.

3.4 REQUEST FOR WARRANTY INSPECTION

A. Request for warranty inspection shall be completed by the roofing applicator and be forwarded to the roofing manufacturer at least 14 days prior to the requested date of inspection. Special information regarding access to the roof shall be included on the request form.

B. The warranty shall be issued to the Owner after satisfactory final inspection by the roofing manufacturer's representative at Substantial Completion.

3.5 CLEANING

A. Upon completion of the Work, remove from the premises all debris and surplus material. Leave the work area in a clean condition and ready for use.

END OF SECTION

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, and equipment required to install flashings, coping and all other sheet metal items required to weatherproof the building.

B. Related Sections:

1. **Division 7 Section "Self-Adhering Sheet Air Barriers" for weather resistant barrier and flexible flashing systems.**

2. Division 7 Section "TPO Single Ply Membrane Roofing."

1.2 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, oil-canning, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

1. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

a. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2. ANSI/SPRI ES198 Test Method RE2 "PullOff Test for Fascia": Fascia system shall be tested in accordance with the ANSI/SPRI test using the current edition of "Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems."

3. ANSI/SPRI ES198 Test RE3 for Coping: Wind Design Guide for Edge Systems Use with Low Slope Roofing Systems (current edition). Coping systems shall be tested simultaneously on horizontal and vertical surfaces and shall exceed horizontal and vertical design wind pressure as calculated in accordance with the ANSI/SPRI test method.

1.3 REFERENCES

A. American Architectural Manufacturers Association (AAMA).

B. American Society for Testing and Materials (ASTM).

C. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) "Architectural Sheet Metal Manual."

1.4 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

C. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.

2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.

3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.

4. Details of termination points and assemblies, including fixed points.

5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.

6. Details of edge conditions as applicable.

7. Details of special conditions.

8. Details of connections to adjoining work.

9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.

3. Accessories and Miscellaneous Materials: Full-size Sample.

F. Qualification Data: For qualified fabricator.

G. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

H. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

D. Build mockup of typical coping approximately 10 feet long, including supporting construction cleats, seams, attachments, and accessories.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.

2. Review methods and procedures related to sheet metal flashing and trim.

3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.

4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.

5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate with roofing installer for installation of all related weatherproofing items and provision of roofing guarantee responsibility.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.8 WARRANTY

A. Furnish a written notarized warranty cosigned with the subcontractor covering both roofing and sheet metal for a period of two years from the date of Substantial Completion, warranting that all surfaces exposed to the weather are watertight and free from defective materials and deficiencies in workmanship, and that he will correct or replace any portion of this Work which fails in the performance of its purpose.

B. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed below.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Coping and Flashings:

1. Galvanized steel sheet, G115 coating designation per ASTM A653, 1.15 oz./s.f. coating, precoated with baked fluoropolymer with 70% PVDF in resin per AAMA 2605.

2. Gauge:

   a. 24 gauge (0.024-inch) minimum thickness for general flashing.

   b. 22 gauge (0.030-inch) minimum for coping caps up to 12-inches in width.

   c. 20 gauge (0.036-inch) minimum for fascias and coping caps 13-inches to 18-inches in width.

   d. Heavier gauges where specifically noted or recommended by SMACNA Manual for size of component.

   e. Steel sheet thickness measured before galvanizing.

3. Custom colors as selected by Architect.

B. Door and Window Flashings, Window Sill Pans, and Other Built-In Flashings: Type 304, flashing grade stainless steel, 0.019-inch (0.48 mm) thick.

C. **Downspouts: Hot-dip galvanized Schedule 40 steel pipe, 4-inch diameter.**

D. Miscellaneous Fabrications: On fabrications of intricate design that do not lend themselves to fabrication with precoated steel, use 24 gauge (0.024-inch) galvanized steel sheet or heavier as recommended by SMACNA Manual for size of component, G115 coating designation per ASTM A653, 1.15 oz./s.f. coating, mill phosphatized. Prime and paint to match color of precoated finish.

E. Non-Skinning Sealant: Tremco TremPro JS-773, non-skinning, non-drying, synthetic, butyl elastomer sealant.

F. Joint Sealant: Dow 790, one part neutral cure low modulus moisture curing silicone.

G. Pre-Manufactured Reglets: Type for two-piece flashing system. Match flashing sheet metal type, gauge, and finish.

1. Fry Reglet Corp. "Springlok."

2. Cheney Flashing Co. "Snap Lock."

3. MM Systems Corp. "Snap-Tite System."

H. Screws: Self-drilling, stainless steel screws with neoprene grommeted washers for use with galvanized or prepainted steel, aluminum and stainless steel sheet. Length to penetrate nailable substrate 3/4-inch, and steel substrate by 3 threads.

I. Paint Primer for Non-Precoated Metals:

1. Galvanized Metal: Etch with phosphoric acid solution prior to applying primer.

2. Ferrous, Non-Ferrous, and Galvanized Metals: One coat ICI Devoe Coatings "4020 Devflex DTM."

PART 3 EXECUTION

3.1 INSTALLATION

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Fabricate all sheet metal items accurately to sizes as detailed, installing same by securely fastening them to the other parts of the work. Do all work, metal forming, etc., to highest standards that will produce weatherproof, properly seamed, joined and sealed work, free from surface stains and wrinkled or buckled finishes. Reinforce seams and folds as required to prevent binding or tearing.

C. Hem all flashings edges 1/2-inch. Lock and seal all joints other than expansion joints. Neatly form joints and seams with surfaces free from waves and buckles. Do not solder prepainted, metallic coated steel and aluminum sheet. Flashing joints shall have a minimum 4-inch overlap with weld/solder or mechanical fastening with sealant.

D. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10-feet with no joints allowed within 24-inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with mastic sealant (concealed within joints). Conceal expansion joints within the system.

E. Seams: Fabricate non-moving seams in sheet metal with flat-lock seams filled with non-skinning butyl sealant concealed within joints.

F. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate silicone elastomeric sealant to comply with SMACNA standards.

G. Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

I. Fabricate metal copings and secure by screws and clips as detailed. Screw coping at 18-inches o.c., on the inside of the curb through the skirt. Metal ends shall lap at least 3-inches and shall have plastic cement between the layers of metal. Do not screw through laps.

J. **All windows shall be set in stainless steel pans and flashed to the exterior.**

3.2 PROTECTION

A. Protect all metal work from damage during the progress of construction. Remove damaged material and replace with new.

END OF SECTION

ROOF ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services necessary for the installation of roof access hatches.

1.2 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Access Hatches:

1. Nystrom, 800-547-2635.

a. http://www.nystrom.com/roof-hatches/personnel

2. Industrial Products, 888-243-3339.

a. http://www.industrialproducts.com/roof-hatches/precision-36-x-96-industrial-galvanized-roof-hatch.html

B. Safety Railing:

1. Nystrom.

2. KeeHatch Railing System.

3. Architectural Specialties, Inc.

C. Safety Post: Milcor.

D. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 ROOF HATCHES

A. Manufacturer/Product: Nystrom, single leaf, 36-inch x 96-inch, RHPG36x96S2T-IPP-FP.

1. Cover: 14 gauge galvanized steel, powder coated, with 3-inch beaded flange, neatly welded. Insulation of 1-inch fiberglass fully covered with 22 gauge steel liner.

2. Curb: 12-inch height and of 14 gauge galvanized steel, powder coated. Formed with 3-1/2-inch flange with holes provided for securing to the roof deck. Curb provided with integral metal cap flashing of same material as the curb, fully welded at the corner. Curb insulation 1-inch thick rigid polyiso board.

3. Hatch: Completely assembled with heavy pintle hinges, compressive spring operators enclosed in telescopic tubes, positive snap latch with handles and padlock hasps inside and outside, and neoprene draft seal. All hardware zinc plated. Cover equipped with an automatic hold open arm complete with vinyl grip handle to permit one hand release.

2.3 ROOF HATCH SAFETY POST

A. Manufacturer: Milcor “Upright Safety Bar,” hatch curb mounted, hinged steel bar, automatic lock in fully extended position.

2.4 ROOF HATCH SAFETY RAILING AND GATE

A. General: OSHA compliant permanent fall protection for roof hatches, OSHA 29 CFR 1910.23 and 1926.502.

B. Materials: Schedule 40 galvanized pipe with fittings. Exact sized rails for field assembly. Galvanized steel mounting brackets with counter-flash mounting and backing nut plate.

C. Manufacturer: Nystrom “Safety Railings,” sized to match roof hatch model.

PART 3 EXECUTION

3.1 INSTALLATION

A. Hatches: Install in accordance with manufacturer's instructions, securely anchoring to roof deck. Coordinate with roofing application to ensure watertight installation.

B. Safety Rail: Bolt to hatch cover curb in accordance with manufacturer's instructions.

C. Safety Post: Bolt to hatch cover curb in accordance with manufacturer's instructions.

END OF SECTION

PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. Related Sections include the following:

1. Division 21 Sections specifying fire-suppression piping penetrations.

2. Division 22 and 23 Sections specifying duct and piping penetrations.

3. Division 26, 27, and 28 Sections specifying cable and conduit penetrations.

1.2 PERFORMANCE REQUIREMENTS

A. Products:

1. Provide products that upon curing do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.

2. When intumescent products are used, provide products that do not contain sodium silicate or any other water soluble intumescent ingredient in the formulation.

3. Provide firestop sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.

4. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.

5. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices shall be:

a. Capable of retrofit around existing cables.

b. Designed such that two or more devices can be ganged together.

c. Maintenance free such that no action is required to activate the smoke and fire sealing mechanism.

6. When mechanical cable pathways are not practical, openings within walls and floors designed to accommodate voice, data and video cabling shall be provided with re-enterable products specifically designed for retrofit.

7. Penetrants passing through fire-resistance rated floor-ceiling assemblies contained within chase wall assemblies shall be protected with products tested by being fully exposed to the fire outside of the chase wall. Systems within the UL Fire Resistance Directory that meet this criterion are identified with the words “Chase Wall Optional.”

8. Provide fire-resistive joint sealants designed to accommodate a specific range of movement and tested for this purpose in accordance with a cyclic movement test criteria as outlined in Standards, ASTM E1966, or ANSI/ UL 2079.

9. Provide penetration firestop systems, fire-resistive joint systems, or perimeter fire barrier systems subjected to an air leakage test conducted in accordance with Standard, ANSI/ UL1479 for penetrations and ANSI/UL2079 for joint systems with published L-Ratings for ambient and elevated temperatures as evidence of the ability of firestop system to restrict the movement of smoke.

10. Provide T-Rating Collar Devices tested in accordance with ASTM E814 or ANSI/UL1479 for metallic pipe penetrations requiring T-Ratings per the applicable building code.

11. Provide moisture-curing products where inclement weather or greater than transient water exposure is expected.

B. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers, and smoke barriers.

2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

C. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

   a. Penetrations located outside wall cavities.

   b. Penetrations located outside fire-resistance-rated shaft enclosures.

3. L-Rated Systems: Provide firestop systems with L Ratings tested in accordance with ANSI/UL1479 (substitute ANSI/UL2079 for joints). For each 100 sq ft (9.3 m2) area, the total cumulative leakage of all firestop systems shall not exceed 50 CFM (0.024 m3/s).

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.

3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

E. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E84, and that are paintable products that shall be finished to a smooth surface, flush with adjacent surfaces.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product Data: For each type of product required.

C. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.

2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.

3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

E. Qualification Data: For Installer.

F. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.

G. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an installer with commercial experience, who is certified, licensed, and FM Global approved in accordance with FM Global 4991, "Approval of Firestop Contractors," or Certified by UL as a Qualified Contractor. A manufacturer’s willingness to sell its firestopping products to Contractor or to an installer engaged by Contractor does not in itself confer qualifications on buyer.

B. Certified and licensed company names and contact information for Oregon.

1. PCI ISSD/ Randy Johnson 503-519-4084

2. Hudson Bay / Aaron Garcia 503-545-3367

3. Western Partitions / Cody Rubric 503-519-4339

4. PCI Interior division / Colin McCool 360-772-2747

5. ICON (Insulation Contractors) / Alan Smith 360-823-1390

C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.

2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:

a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.

b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in its "Fire Resistance Directory."

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide through-penetration firestop systems appropriate for the penetration condition.

B. Subject to compliance with through-penetration firestop systems (XHEZ) and/or joint systems (XHBN) listed in Volume 2 of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

1. Specified Technologies Inc., STI.

2. Hilti Inc.

3. 3M Fire Protection Products.

4. Metacaulk.

5. BioFireshield

6. Spec Seal.

C. Firestop sealants used at joints and penetrations through acoustically significant construction shall be in accordance with Division 7 Section “Acoustical Joint Sealants.”

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by

qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
    a. Slag-/rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
    d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket.

C. Intumescent Sealants: Single component intumescent latex formulations containing no water soluble intumescent ingredients capable of expanding a minimum 8 times.

D. Endothermic Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture.

E. Elastomeric Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture and accommodate minimum ±25 percent movement.

F. Firestop Devices: Factory-assembled steel collars lined with intumescent material capable of expanding a minimum 30 times sized to fit specific outside diameter of penetrating item.

G. Fire Rated Cable Pathways: Gangable device modules capable of being retrofitted around existing cables and comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill and requiring no additional action in the form of plugs, twisting closure, putty, pillow, or sealant to achieve fire and leakage ratings.

PENETRATION FIRESTOPPING

H. Intumescent Composite Sheets: Intumescent material sandwiched between a galvanized steel sheet and steel wire mesh protected with aluminum foil capable of sustaining a minimum 2,500 lbs (1,134 kg) when subjected to load.

I. Intumescent Putties: Intumescent, non-hardening, water resistant, butyl rubber based putties containing no solvents, inorganic fibers or silicone compounds.

J. Wall Opening Protective Materials: Intumescent, non-curing pads or inserts for protection of electrical switch and receptacle boxes.

K. Intumescent Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film and capable of expanding a minimum 30 times.

L. 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.

M. Pillows/Bags: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating on all six sides contained in a flame retardant poly bag.

N. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

O. All-Weather Coatings: Moisture curing, single component silicone copolymer elastomeric spray coatings for horizontal surfaces where greater water resistance is required or inclement weather is anticipated.

P. Firestop Plugs: Re-enterable, foam rubber plug impregnated with intumescent material capable of expanding minimum 10 times with expansion beginning at 350°F (177°C) for use in blank openings and cable sleeves.

Q. Fire-Rated T Rating Collar Device: Louvered steel collar system with synthetic aluminized polymer coolant wrap installed on metallic pipes where T Ratings are required by applicable building code requirements.

R. Fire-Rated Cable Grommet: Molded two-piece grommet made from plenum grade polymer with a foam inner core for sealing cable penetrations up to 0.53 in. (14 mm) diameter.

S. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surface (nonsag)

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.

3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop 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 work.

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

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system 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 through-penetration firestop systems.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop 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.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

PENETRATION FIRESTOPPING

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing 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 indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.

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 Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes, ready to be painted.

3.4 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted metal, vinyl or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

2. Contractor's name, address, and phone number.

3. Through-penetration firestop system designation of applicable testing and inspecting agency.

4. Date of installation.

5. Through-penetration firestop system manufacturer's name.

6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop 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 through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.7 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. Systems shall be UL-classified and listed in UL's "Fire Resistance Directory" under product Category XHEZ.

1. Firestop Systems with No Penetrating Items.

2. Firestop Systems for Metallic Pipes, Conduit, or Tubing.

3. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing.

4. Firestop Systems for Electrical Cables.

5. Firestop Systems for Cable Trays.

6. Firestop Systems for Insulated Pipes.

7. Firestop Systems for Miscellaneous Electrical Penetrants.

8. Firestop Systems for Miscellaneous Mechanical Penetrants.

9. Firestop Systems for Groupings of Penetrants.

END OF SECTION

JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the installation of building sealants for weatherproofing and joint filling including, but not limited to:

1. Perimeter joints of jambs, sills and trim.

2. Perimeter of door and window frames.

3. Penetrations of mechanical, electrical, and roof drainage equipment and parts through exterior wall, soffit and trim.

4. Construction and expansion joints.

5. Steel deck flutes above partition walls.

6. Miscellaneous sealant products used throughout job.

7. Sealing bottom of form tie holes on concrete.

B. Related Section: Division 7 Section “Acoustical Joint Sealants.”

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. Federal Specifications (FS).

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.

2. Conduct field tests for each kind of sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.

4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Methods:

(1) Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix XI in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

(2) ASTM C794-06 Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.

b. 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.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.5 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product data from manufacturers for each joint sealant product required.

C. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

G. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

H. Installer’s experience qualifications.

I. Sample warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

B. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

D. Field-Constructed Mock-Ups:

1. Prior to installation of joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution.

2. Install joint sealants in field-constructed mock-ups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants specified in this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40°F.

2. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.9 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period. Include repair and replacement of defective work, such as leaks, failure of material, loss of adhesion, running of compound, or staining of adjacent work.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period:

a. 20 years from date of Substantial Completion for silicone sealants.

b. 10 years from date of Substantial Completion for Silyl-Terminated-Poly-Ether (STPe) sealants.

c. 5 years from date of Substantial Completion for acrylic latex sealants.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

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 other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed in Paragraph 2.3.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors: Provide custom colors of exposed joint sealants to match Architect's samples.

2.3 ELASTOMERIC JOINT SEALANTS

A. Sealant 1:

1. One part neutral cure medium modulus moisture curing silicone, FS TT-S-00230C, Type 2, Class A, or ASTM C920, Type S, Grade NS, Class 25. Uses NT, M, G, A, and O, and capable of withstanding movement of 50% in extension and compression in service.

2. Products:

a. Dow Corning "795."

b. Pecora "895 NST" (non-staining technology).

c. Tremco "Spectrem 2."

B. Sealant 2:

1. One part low modulus moisture curing silicone, FS TT-S-00230C, Type 2, Class A, TT-S-001543A, Class A, or ASTM C920, Type S, Grade NS, Class 100/50. Uses NT, M, G, A, and O, and capable of withstanding movement of 100% in extension and 50% in compression in service.

2. Products:

   a. Dow Corning "790."

   b. G.E. "Silpruf SCS 2000."

   c. Pecora "890 FTS" (field-tintable, non-staining technology).

   d. Tremco "Spectrem 1."

C. Sealant 3:

1. One part mildew resistant silicone sealant, FS TT-S-00230C, Class A, TT-S-1543A, Class A, or ASTM C920, Type S, Grade NS, Class 25. Uses NT, A and as applicable to non-porous joint substrates indicated, O, formulated with fungicide, intended for sealing interior joints with non-porous substrates and subject to in-service exposure to conditions of high humidity and temperature extremes.

2. Products:

   a. Tremco "Tremsil 200."

   b. Pecora "898."

D. Sealant 4:

1. One part, neutral cure sealant, designed for adhering to low energy surfaces common in sheet or peel and stick weather resistant barriers.

2. Products:

   a. Dow Corning “758 Silicone Weather Barrier Sealant.”

   b. PROSOCO, Inc., “R-Guard AirDam” STPe sealant.

   c. Henry “HE925-BES Sealant” STPe sealant.

E. Sealant 5:

1. One part acrylic latex sealant, ASTM C834.

2. Products:

   a. Tremco "Acrylic Latex 834" paintable caulk.

b. Pecora "AC-20" paintable caulk.

F. Acoustical sealants used at joints and penetrations through acoustically significant construction shall be in accordance with Division 7 Section “Acoustical Joint Sealants.”

2.4 COMPRESSION PRESSURE SEALANTS

A. Compression Pressure Sealant: Dayton Superior Chemical Products, "Polytite R" one-step joint sealant. Polyurethane foam strip saturated with non-migrating polybutylene sealant, and elastomeric skin on the exterior surface. Permanent recovery expansion and resiliency type. Color as selected by Architect. Adhesive where required as recommended by manufacturer.

2.5 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; compatible with joint substrates, sealants, primers and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers:

1. Preformed, compressible, resilient, non-staining, non-waxing, non-exuding strips of flexible plastic foam of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2. Material: Bi-cellular material consisting of closed cell extruded polyolefin foam with nonabsorbing outer skin, non-outgassing when punctured, ASTM C1330, Type B.

3. Products:

a. Nomaco "SOF ROD."

b. Backer Rod Manufacturing, Inc., “TITAN FOAM.”

C. Bond Breaker Tape: Polyethylene tape or other plastic tape as 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.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant substrate tests and field tests.

B. Cleaners for Non-Porous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent non-porous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

D. Sanded Joints: Clean masonry sand, ASTM C144.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic 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, glazed surfaces of ceramic tile, and other non-porous 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 indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. 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 OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Sealant Installation Standard: For joint sealants as applicable to materials, applications, and conditions indicated, per ASTM C1193.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

a. Do not leave gaps between ends of joint fillers.

b. Do not stretch, twist, puncture, or tear joint fillers.

c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

D. Installation of Sealants: Install sealants by proven techniques that result 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 the same time sealant backings are installed.

E. Tooling of Non-Sag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, 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 or are not approved by sealant manufacturer.

1. Provide concave joint configuration per Figure 5A in ASTM C1193, unless otherwise indicated.

2. Provide flush joint configuration, per Figure 5B in ASTM C1193, where indicated.

3. Provide recessed joint configuration, per Figure 5C in ASTM C1193, of recess depth and at locations indicated. Use masking tape to protect adjacent surfaces of recessed tooled joints.

4. Sanded Joints: Embed clean masonry sand in the exposed surface of joint sealants that occur in masonry construction.

F. Installation of Compression Pressure Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with

sealant manufacturer's directions for installation methods, materials, and tools that produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations. Install in steel deck flutes above non-fire rated partition walls and exterior walls to completely fill the flute and seal the wall to the bottom of the steel deck. Install elsewhere as detailed.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that installations with repaired areas are indistinguishable from original work.

3.6 SCHEDULE

A. Primerless Type Silicone Sealant: Exterior and interior joints in vertical surfaces of concrete and masonry, between metal and concrete, or mortar, and all other exterior joints not indicated otherwise; general exterior sealing of door and window frames, penetrations, form tie holes, toilet room fixtures, and building expansion and control joints.

1. Medium modulus type for ±50% joint movement, general building sealing and joints bordering glass: Sealant 1.

a. Sealant 1 is structural silicone and is the only sealant to use for structural glazed insulating glass units, but can also be used where no, or very little movement is expected such as sealing form tie holes, around toilet room fixtures, and joints between like-materials that don't expand and contract differently, and are not expansion joints.

2. Low modulus type for expansion and control joints with +100% to -50% movement and joints bordering brick or concrete: Sealant 2.

a. Sealant 2 can be used in all locations that Sealant 1 is used, except structural glazing. Sealant 2 must be used in expansion/contraction joints, and between materials with different coefficients of expansion, i.e, steel/concrete, aluminum/steel, etc.

B. Mildew Resistant Silicone: Interior wet areas, Sealant 3.

C. Bedding and Joint Sealant between self-adhering flexible flashing and Window/Flashing. Sealant 4.

D. Acrylic Emulsion Sealant: Interior joints in field-painted vertical and overhead surfaces; at perimeter of elevator door frames and hollow metal door frames; in gypsum board, concrete and concrete masonry; and all other interior joints not indicated otherwise: Sealant 5.

E. Compression Pressure Sealant: General construction joint sealant for areas of movement and climatic extremes; sealing of metal deck flutes at walls.

END OF SECTION

ACOUSTICAL JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY:

A. Seal interior joints and penetration openings in a manner that prevents transmission of airborne noise and structural vibration into acoustically sensitive/critical spaces. Penetrations shall include conduit, duct, pipe, cable, recessed boxes, and other penetrants, assemblies, or devices noted in the Documents.

1.2 RELATED WORK:

A. Section 03 30 00 - Cast-In-Place Concrete.

B. Section 04 22 00 - Concrete Masonry Units.

C. Section 07 84 13 – Penetration Firestopping.

D. Section 07 92 00 – Joint Sealants.

E. Section 09 21 16 - Gypsum Board Assemblies.

F. All Div. 21, 22, 23, 26, 27 specifications with regards to building service systems that penetrate walls, floors, and ceilings.

1.3 SUBMITTALS

A. Submit manufacturer's data sheet for all acoustical sealants and putty pads. If requested, provide samples to Architect and Acoustics Consultant.

1.4 STANDARDS

A. ASTM C510. Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealant, 1990.

B. ASTM C639. Test Method for Rheological (Flow) Properties of Elastomeric Sealants, 1990.

C. ASTM C719. Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement, 1993.

D. ASTM D412. Test Method for Vulcanized Rubber and Thermo-Plastic Rubbers and Thermo-Plastic Elastomers/Tensions, 1992.

E. ASTM D2240. Test Method for Rubber Property- Durometer Hardness, 1991.

F. American Association of State Highway and Transportation Officials (AASHTO), Standard Specifications for Highway Bridges, Thirteenth Edition, 1992. See Table 25.2B for physical property requirements of bridge bearing quality neoprene.

1.5 DEFINITIONS

A. Recessed Box: A box that is recessed behind gypsum board assemblies for the installation of a receptacle, switch, data/telephone outlet, fire alarm device, or any other purpose including future use.

PART 2 PRODUCTS

2.1 ACOUSTICAL SEALANTS

A. Acoustical sealants shall have the following properties:

1. Hardness of no more than 50 durometer Shore A as rated in ASTM D2240.

2. Minimum elongation of 500% as rated in ASTM D412.

3. Minimum joint width movement of 25% as rated in ASTM C719.

4. Self Leveling type (S/L) if applied on floors in accordance with ASTM C639.

5. Non-Sag type (N/S) if applied on walls in accordance with ASTM C639.

6. Acoustical sealants must meet the following additional requirements where applied in exposed locations:

a. Acoustical sealants shall be paintable.

b. Acoustical sealants shall be skinning type.

c. Acoustical sealants shall be non-staining type as rated in ASTM C510.

B. For concealed locations, acoustical sealants shall be one of the following approved products. Substitutions are unacceptable unless otherwise approved by the Architect and project Acoustics Consultant.

1. Tremco Acoustical Sealant

2. GE SilPruf SCS2000

3. PTI Architectural Sealant 707

C. For exposed locations, acoustical sealants shall be one of the following approved products. Substitutions are unacceptable unless otherwise approved by the Architect and project Acoustics Consultant.

1. DAP Dynaflex 230

2. GE SCS7000

3. Sikaflex 1a

D. For fire-rated locations, acoustical sealants shall be one of the following approved products. Substitutions are unacceptable unless otherwise approved by the Architect and project Acoustics Consultant.

1. HILTI CP 601S

2. STI Spec Seal PEN300

3. Tremco Fyre-Sil

4. Johns Manville Firetemp CI

2.2 PUTTY PADS

A. Putty pads shall be made from polybutene-butyl with inert fillers or other approved permanently resilient self-adhering material.

B. Putty pads shall have a minimum thickness of 1/8-inch.

C. For non-rated locations, putty pads shall be the following approved product. Substitutions are unacceptable unless otherwise approved by the Architect and project Acoustics Consultant.

1. Harry A. Lowry & Associates Outlet Box Pads

D. For fire-rated locations, putty pads shall be one of the following approved products. Substitutions are unacceptable unless otherwise approved by the Architect and project Acoustics Consultant.

1. Hevi-Duty Nelson FSP Putty Pads

2. STI Spec Seal SSP Putty Pads

3. 3M Fire Barrier Putty Pads

2.3 PACKING MATERIAL

A. Packing material shall be of the following types:

1. Mineral Fiber

2. Glass Fiber

3. Preformed Pipe Insulation

4. Others as approved by the acoustical sealant manufacturer and project Acoustics Consultant.

2.4 BACKER ROD

A. Provide cylindrical closed-cell polyethylene foam backer rod with diameter 25% larger than joint width.

PART 3 EXECUTION

3.1 EXTENT

A. Resiliently seal all joints and penetrations (conduit, ducts, pipes, cables, recessed boxes, etc.) using acoustical sealant and/or putty pads through all walls, floors, and ceilings of the following spaces:

1. Spaces with ambient noise level criteria of RC 34 and lower as listed in Section 01 86 36: Ambient Noise Performance Requirements.

B. At double-wall or triple-wall partitions, resiliently seal penetrations at each wall.

C. If the Contract Documents seem unclear, request clarification of extent from the Architect.

3.2 ACOUSTICAL SEALANTS

A. Opening Requirements

1. In metal stud assemblies, each penetrant must be housed in an individual opening properly sized for that penetrant. Routing multiple penetrants through a single opening is not allowed. The following requirements apply:

a. Provide a minimum of 2x wood blocking or 2 layers of 3/4” plywood spanning between studs for pipe, conduit, cable, and round duct penetrants to form the opening without the use of a sheetmetal sleeve.

b. Frame openings for rectangular duct penetrants without the use of a sheetmetal sleeve.

c. The space between the opening and the penetrant shall be 1/2-inch minimum to 3/4-inch maximum around the penetrant. The penetrant shall be centered within the opening to prevent contact between the opening and the penetrant.

2. In masonry or precast concrete assemblies, each penetrant must be housed in an individual opening properly sized for that penetrant. Routing multiple penetrants through a single opening is not allowed. The following requirements apply:

a. At masonry assemblies, properly form openings to minimize the grout needed between the opening and the sleeve.

b. Provide sleeves that are grouted in place. Sleeve ends shall be flush with surrounding substrates. Provide infill around all sleeves with material of surface weight equal to or greater than the surrounding substrate. All void spaces between sleeve and masonry or precast concrete must be filled airtight.

c. In grout-filled masonry or precast concrete, properly sized core drilled holes may be used in lieu of sleeves.

d. The space between the sleeve and the penetrant shall be 1/2-inch minimum to 3/4-inch maximum around the penetrant. The penetrant shall be centered within the opening to prevent contact between the sleeve and the penetrant.

e. At multi-wythe partitions, provide separate sleeves at each wythe. Sleeves may not bridge airspace(s) of multi-wythe partitions.

4. In poured concrete assemblies, penetrants can be housed in an individual opening properly sized for that penetrant or housed in an opening properly sized for several penetrants. When multiple penetrants are housed in a single opening, the following requirements apply:

a. Each penetrant must be sleeved.

b. Sleeve ends shall be flush with surrounding substrates. Provide infill around all sleeves with material of surface weight equal to or greater than the surrounding substrate. All void spaces between sleeves and concrete must be filled airtight.

c. The space between the sleeve and the penetrant shall be 1/2-inch minimum to 3/4-inch maximum around the penetrant. The penetrant shall be centered within the opening to prevent contact between the sleeve and the penetrant.

d. At multi-wythe partitions, provide separate sleeves at each wythe. Sleeves may not bridge airspace(s) of multi-wythe partitions.

B. Clearances

1. Maintain a 4-inch minimum clear space around duct penetrations so that an airtight seal can be easily installed without conflicts from nearby penetrants, floors, ceilings, walls, or other obstructions.

2. Maintain a 2-inch minimum clear space around all other penetrations so that an airtight seal can be easily installed without conflicts from nearby penetrants, floors, ceilings, walls, or other obstructions.

C. Sealing

1. Do not proceed with installation if opening requirements or other requirements specified herein are not met. Conditions shall be corrected to meet the requirements of this Specification before sealant is installed.

2. Loosely fill space between opening or sleeve and penetrant with clean packing material to be nearly flush with both ends of opening or sleeve.

3. Prepare and install backer rod material in accordance with manufacturer's recommendations for proper application of sealant.

4. Seal both ends of penetration with liberal bead of sealant applied continuously around the penetration and jointed end-to-end to form an airtight, continuous membrane.

a. Sealant shall completely fill the space surrounding the penetrant.

b. Sealant thickness at midpoint of hourglass shape shall be 50% of the joint width.

5. When complete, sealant shall be flush with surrounding substrate.

3.3 PUTTY PADS

A. Brush or wipe construction dust and dirt from recessed box.

1. If surface is contaminated with oil, wipe with xylene or toloulene to remove oily residue.

B. Before mounting recessed box or attaching conduit, adhere putty pad to box back and mounting side(s). Leave 1/2-inch minimum overlap along the front surface to enable wrapping of plaster ring.

C. Mount recessed box and install plaster ring. Tighten all loose fasteners.

D. Continue wrapping recessed box, all conduit attachments and plaster ring with putty pad. Press putty pad firmly into surfaces.

1. If necessary, cut and apply additional pieces of putty pad to achieve an airtight seal around the recessed box, conduit attachments, and plaster ring.

E. After gypsum board installation, press putty pad firmly against gypsum board to create an airtight seal.

1. If airtight seal is not continuous around the plaster ring perimeter, seal any gaps or voids with a liberal bead of acoustical sealant to create an airtight seal.

3.4 PUTTY

A. Brush or wipe construction dust and dirt from cables and conduit.

1. If surfaces are contaminated with oil, wipe with xylene or toloulene to remove oily residue.

B. Properly space cables away from each other inside the conduit.

C. Tightly pack mineral fiber between all cables.

1. Pack mineral fiber tight around cables the full depth of the sleeve, holding back the mineral fiber 1/4” from both ends of the conduit sleeve.

D. Fill all spaces between the cables and conduit with putty to a 1/4” depth to create an airtight seal. The putty shall be flush with both ends of the conduit sleeve or conduit stub.

END OF SECTION

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services required for the fabrication and installation of hollow metal doors and frames. Include all required anchor bolts and devices.

B. Related Section: Division 8 Section “Sound-Rated and Sound-Control Doors.”

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. Hollow Metal Manufacturers Association's (HMMA) standards published by the National Association of Architectural Metal Manufacturers (NAAMM).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings showing anchor locations, hardware, and other pertinent installation information.

1.4 QUALITY ASSURANCE

A. Provide doors and frames complying with HMMA standards published by NAAMM. Manufacturer shall be assessed and registered as meeting the requirements of Quality Systems under ISO 9001.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver to job in time for building into walls and protect from weather and construction damage. Replace dented or bent hollow metal work with new undamaged work as directed. Filled dents and straightened work are not acceptable.

1.6 WARRANTY

A. Provide manufacturer's 2 year warranty against rust and paint adhesion failure for all doors and frames.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Doors and frames shall be custom manufactured by the same manufacturer.

B. Metal Door and Frame Manufacturers:

1. Amweld Building Products, 800/248-6116.

2. Benson Industries, 503/226-7621.

3. Curries Company, 515/423-1334.

4. Deansteel Manufacturing, 800/825-8271.

5. Grand Openings, 503/235-3105.

6. NCS Manufacturing, 605/343-5486.

7. Stiles Custom Metal, Inc., 209/538-3667.

8. Ceco Door Products, 509/455-8239.

9. Steelcraft, 513/745-6400.

10. Fleming Steel Doors And Frames, 800/263-7515.

C. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 FABRICATION

A. Sound Rated Assemblies: Frames at sound-rated and sound-control doors shall be in accordance with Division 8 Section “Sound-Rated and Sound-Control Doors.”

B. Frames: Fabricate accurately with all breaks, arises, and angles or curves uniform, straight, sharply defined and true. Miter fit and full weld all corners, weld seams and grind smooth to produce an invisible joint. All fastenings concealed where possible.

C. Doors and frames formed from minimum 16 gauge (0.054-inch thick) commercial quality cold-rolled steel conforming to ASTM A366 or tension leveled steel conforming to ASTM A924, galvanized to ASTM A653, commercial steel, type B, coating designation A40, commercially known as paintable galvanneal. Steel for fabrication of all members exposed on exterior walls shall be galvanized to ASTM A653 with a minimum total coating weight of A60, 0.60 oz./s.f. (0.058 minimum thickness).

D. Flush panel doors shall be 1-3/4-inches thick, reinforced and welded full length at joints, and ground smooth. Reinforce doors 6-inches o.c. vertically. Lock reinforcing shall be provided between faces of door to prevent collapsing of door faces and side movement of latch and face plate. Void spaces in door shall be sound deadened and filled full height with insulating material. Exterior doors and doors in high moisture areas shall have additional flush closure channel at top and bottom edge. Seal top door edge watertight with silicone sealant. Provide openings in bottom closure to permit escape of moisture.

E. Frames for doors to be type, design and size as detailed. Provide 12 gauge (0.097-inch) minimum channel reinforcing in the head of frames over 3-feet in width and other frame locations as detailed. Provide not less than four anchors at each jamb including a 16 gauge (0.054-inch) bent

plate anchor clip at the bottom. Provide for three rubber silencers in all door frames on lock side on frames not equipped with weather stripping.

F. Provide suitable sinkages in doors and frames for all mortised or countersunk hardware, with steel reinforcement inserted for attaching hardware. Reinforcement of doors and frames to be as follows:

1. Hinge Pockets: Reinforce hinge pockets with 3/16-inch thick x 12-inch long x full frame width steel backing welded fabrication.

2. All Other Hardware Mountings: Reinforce all other hardware mountings at heads, jambs, stiles, or rails with minimum 12 gauge (0.097-inch) steel plate welded fabrication at all machine screw sinkages and 16 gauge (0.054-inch) minimum at all cylinder lock hole locations to prevent collapsing of doors and malfunctioning of hardware. Double gauge sheet metal reinforcing is not acceptable for hardware backing.

2.3 FINISH

A. Cold-Rolled Steel: Sand surfaces smooth eliminating all weld marks; chemically clean and "Bonderize" after fabrication. Paint with rust inhibiting ferrous metal primer and oven dry. All finished surfaces smooth, uniformly protected, and ready for finish painting on the job site. All exposed screw heads filled and ground smooth.

B. Galvanized Steel: Touch up with zinc-rich primer only at areas where galvanizing has been removed during fabrication.

C. Frames detailed to be grout filled shall receive a protective bituminous coating on the inside surfaces of the frame. Provide grout boxes at frame penetrations.

2.4 HARDWARE

A. The door manufacturer shall be furnished with hardware templates by the finish hardware supplier. Doors and frames shall be prepared for hardware at the factory. Out-of-state door manufacturers are required to pay for all hardware shipping charges.

B. All hardware shall be attached by machine screws, threaded into reinforced tapped holes or through-bolted. All drilling and tapping for mortised hardware shall be done at the factory. Self-tapping sheet metal screws or welding is not permitted.

PART 3 EXECUTION

3.1 INSTALLATION

A. Sound Rated Assemblies: Clearance at frames for sound-rated and sound-control doors shall be in accordance with Division 8 Section “Sound-Rated and Sound-Control Doors.”

B. Frames: Install metal frames in accordance with manufacturer's instructions. Anchor frame to wall and floor as recommended by manufacturer.

C. Doors: Fit doors to frame providing clearances recommended by door manufacturer.

3.2 COMPLETION

A. Adjust door clearances and hardware placement to allow smooth door operation. Touch up scratched door and frame prime paint to match adjacent surfaces. Touch up damaged galvanized surfaces with zinc-rich primer.

END OF SECTION

INTERIOR ALUMINUM FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all material, equipment, labor and services necessary for the installation of extruded aluminum door frames, and relite frames.

B. Related Sections:

1. Division 7 Section "Joint Sealants."

2. Division 8 Sections “Wood Doors” and "Door Hardware."

3. Division 8 Sections “Sound-Rated and Sound-Control Doors” and “Sound Control Windows.”

1.2 REFERENCES

A. Aluminum Association Standards (AA).

B. American Architectural Manufacturers Association (AAMA).

C. American Society for Testing and Materials (ASTM).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings for each door frame and relite frame including:

1. Layout and installation details, including relationship to adjacent work.

2. Elevations at 1/4-inch scale.

3. Detail sections of typical composite members.

4. Anchors and reinforcement.

5. Hardware mounting heights.

6. Glazing details.

C. Product data: Manufacturer’s standard details and fabrication methods. Include information on factory finish, glazing gaskets, accessories and other required components.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Provide aluminum frames and accessories produced by a single manufacturer for each type of product indicated.

B. Manufacturer's qualifications: Company specializing in the manufacturing of door frame systems with a minimum of 10 years of documented experience on a comparable sized project.

1.5 DELIVERY STORAGE AND HANDLING

A. Deliver frames cartoned to provide protection during transit and storage at project site.

B. Inspect frames upon delivery for damage.

1. Repair minor damage to pre-finished products by means as recommended by the manufacturer.

2. Replace frames that cannot be satisfactorily repaired.

C. Store frames at the project site under cover and as near as possible to the final installation location. Do not use covering material that will cause discoloration of aluminum finish.

1.6 PROJECT CONDITIONS

A. Do not begin installation of the frames until the area of work has been completely enclosed and the interior is protected from the elements.

B. Maintain temperature and humidity in areas of installation within reasonable limits, as close as possible to final occupancy. If necessary, provide temperature control and ventilation to maintain required environmental conditions.

1.7 WARRANTY

A. Warrant against defects in manufacturing of materials for a period of 2 years from date of substantial completion.

B. Warrant framing finish against defects for a period of 5 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Framing System: "Trifab VG 450" framing system by Kawneer Co.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Sound Rated Assemblies: Frames at sound-control doors and sound-control windows shall be coordinated with Division 8 Section "Sound-Rated and Sound-Control Doors" and Section "Sound-Control Windows."

B. Aluminum Extrusions: Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" wall thickness at any location for the main frame and complying with ASTM B 221, 6063-T6 alloy and temper. Members true to detail and free from defects impairing appearance, strength or durability.

C. Continuous run joints centered on intersecting vertical or horizontal members and at other approved braking points. Back-up butted joints in continuous runs with concealed tongue and clip. Design for fully concealed fastenings.

D. Exposed fasteners of aluminum or stainless steel. Concealed fasteners may be cadmium or zinc plated steel in accordance with ASTM B766 and ASTM B633.

E. Cold-rolled steel conforming to ASTM A283, Grade C, bonderized and prime painted. All steel members must be properly insulated from aluminum contact.

2.3 FABRICATION

A. Wall components of factory-fabricated parts and assemblies designed for job site erection with a minimum of field labor. Design system to provide for expansion and contraction through an ambient temperature range of 120ºF without buckling or opening of joints.

B. Vertical and horizontal members, 1-3/4-inch face width by 4-1/2-inch deep and accommodating infill with edge thickness 1/4-inch. Nominal glazing edge depth 1/2-inch.

C. Glazing Materials: Resilient EPDM elastomers field-installed under pressure.

D. Finish: All exposed surfaces free of scratches and surface blemishes and given an Architectural Class 2 clear anodized coating conforming with AA-M12C22A21.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine project conditions and verify that the work of this section may properly commence. Do not proceed with the installation until unsatisfactory conditions have been corrected.

B. Verify that the wall thickness does not exceed manufacturer's recommended tolerances of specified frame throat size.

3.2 INSTALLATION

A. Sound Rated Assemblies: Clearance at frames for sound-control doors and sound-control

windows shall be in accordance with Division 8 Section “Sound-Rated and Sound-Control Doors” and Section “Sound-Control Windows.”

B. Comply with frame manufacturer’s printed installation instructions and reviewed shop drawings. Strictly adhere to maintaining specified wall thickness to insure dimension does not exceed frame throat size specified. Installation not to be attempted in areas where the wall thickness exceeds the tolerance of the specified throat size.

C. Install frames plumb and square, securely anchored to substrates with fasteners recommended by frame manufacturer.

1. Use concealed installation clips to assure that splices and connections are tightly butted and properly aligned.

2. Secure clips to main structural extrusion components and not to snap-in or trim members.

3. Do not use screws or other fasteners that will be exposed to view when installation is complete.

D. Protect aluminum from galvanic attack where in contact with dissimilar metals by approved paints or tape.

3.3 CLEANING AND PROTECTION

A. Protect aluminum finishes during installation, glazing and after erection from stains, scratches, and other finish damage. Thoroughly clean aluminum surfaces using approved wax cleaners, soap and water; do not use abrasives, strong alkaline or acid cleaners on aluminum. Protection from subsequent work and final cleaning as specified in Division 1.

END OF SECTION

WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Provide all labor, material, equipment and services necessary to furnish and install wood flush face doors, and stile and rail wood doors.

B. Related Sections:

1. Division 8 Section “Door Hardware.”

2. Division 8 Section “Sound-Rated and Sound-Control Doors.”

3. Division 9 Section “Painting.”

1.2 REFERENCES

A. Architectural Woodwork Quality Standards (AWS): Architectural Woodwork Standards, Guide Specifications and Quality Certification Program, Edition 1, adopted and published jointly by Architectural Woodwork Institute, Architectural Woodwork Manufacturers Association of Canada and The Woodwork Institute.

B. Wood Door Manufacturers Association (WDMA).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product data for each type of door, including details of core and edge construction, trim for door lite openings and louvers.

C. Shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, requirements for veneer matching and other pertinent data. For factory-machined doors, indicate dimensions and locations of cutouts for locksets.

D. Samples for verification: Corner sections of doors approximately 12-inches square with door faces and edgings representing the typical range of color and grain for each species of veneer and solid lumber required.

E. Certification: Manufacturer’s letter of certification of specification compliance.

1.4 QUALITY ASSURANCE

A. Flush Doors: Doors shall comply with WDMA Industry Standard I.S. 1A-11 Architectural Wood Flush Doors and AWS Quality Standards. Any door not meeting these standards shall be replaced without cost to the Owner.

1. Solid Core Doors: Fabrication shall comply with AWS SLC-5, SCLC-5, SLC-7, or SCLC-7 construction for non-rated doors.

B. Stile and Rail Doors: Doors shall comply with WDMA Industry Standard I.S. 6A-11 Architectural Stile and Rail Doors and AWS Quality Standards. Any door not meeting these standards shall be replaced without cost to the Owner.

C. Doors shall bear a temporary tag including the manufacturer's name with full description of face veneer assembly, species, cut, match, door type, elevation, size, hardware machining information, providing for total reconciliation with their submittals and the wood door specification. Such tag shall be affixed to the top of the door.

D. Manufacturer to provide a statement of certification as to their intended full compliance with the wood door specification.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect during transportation handling and storage from surface damage, moisture and soiling. Doors hung and protected as soon as possible after delivery.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Provide manufacturer's full lifetime warranty of original installation including rehanging and refinishing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product Manufacturers:

1. Algoma.

2. Eggers Industries.

3. Vancouver Door Company.

4. VT Industries.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MANUFACTURED UNITS

A. Sound Rated Assemblies: Wood doors at sound-control doors shall be in accordance with Division 8 Section “Sound-Rated and Sound-Control Doors.”

B. Solid Core Doors:

1. WDMA Door Aesthetic Grade: Premium.

2. WDMA Performance Duty Level: Extra heavy duty.

3. Structural-Composite-Lumber-Core Doors:

a. Structural Composite Lumber: WDMA I.S.10.

(1) Screw Withdrawal, Face: 700 lbf (3100 N).

(2) Screw Withdrawal, Edge: 400 lbf (1780 N).

4. Provide doors with either glued-wood-stave or structural-composite-lumber cores.

5. Premium grade five-ply and seven-ply architectural doors with stiles and rails bonded to the core by means of a thermal setting (hot press) adhesive and sanded prior to assembly of face veneers.

6. All doors have double banded laminated stiles without finger joints in outer band and outer band at least 1/2-inch thick. Outer band same species as face veneer, bonded to the core. Laminated stile1-3/8-inches minimum thickness after trim.

7. Door thickness 1-3/4-inches.

8. Veneers:

a. Doors with Transparent Finish:

(1) Premium face (Grade AA, edge glued joints), quarter sawn, center and book matched select white oak.

(2) Face veneers tight and smoothly cut, joints parallel to the edges of the door, and without sharp contrasts in color or grain.

(3) Individual pieces of veneer forming the face veneer edge glued with a thermosetting adhesive. 6-inch minimum flitch width per AWS.

(4) Minimum 1/50-inch veneer thickness at 12% moisture content before sanding at project site.

(5) Double doors to be matched.

C. Stile and Rail Doors:

1. WDMA Door Aesthetic Grade: Premium.

2. WDMA Performance Duty Level: Extra heavy duty.

a. Veneer Grade, Cut, Species, and Match: AA, quarter sawn, center and book matched select white oak.

b. Face veneers tight and smoothly cut, joints parallel to the edges of the door, and without sharp contrasts in color or grain.

c. Individual pieces of veneer forming the face veneer edge glued with a thermosetting adhesive.

d. Minimum 1/50-inch veneer thickness at 12% moisture content before sanding at project site.

3. Door Type: glass.

4. Door Thickness: 1-3/4-inches.

2.3 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

B. Wood doors at sound-control doors shall be field fit to suit frame opening sizes and provide the required clearances in accordance with Division 8 Section “Sound-Rated and Sound-Control Doors.”

C. 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, DHI A115-W series standards, and hardware templates.

D. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2.4 SHOP PRIMING

A. Transparent Finish: After doors have been prepared to receive hardware, shop seal faces and edges of doors for transparent finish as specified in Division 9 Section “Painting.” Seal all four edges, edges of cutouts, and mortises with first coat of finish.

PART 3 EXECUTION

3.1 INSTALLATION

A. Fit with 1/8-inch clearance in frames, head and jambs, 3/16-inch clearance over saddles and thresholds, and 3/8-inch clearance over floor or floor coverings at openings without saddles and thresholds. Bevel lock and hinge stile edges 1/8-inch in 2-inches to operate without binding. Undercut when specially noted on the Drawings or as scheduled. Fit for other clearances when required by special details, hardware, or floor coverings as approved by Architect.

B. Accurately locate surface-mounted hardware on doors by dimension, jig, and template. Pre-drill all screw fastening device holes.

END OF SECTION

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services for the installation of access panels in walls and ceilings for access to concealed equipment and closed spaces as detailed.

B. Related Sections: Refer to Divisions 21, 22 and 23 for mechanical equipment access requirements.

1.2 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings and manufacturer's instructions submitted to Architect for review before ordering. Show installation details, list all required parts and accessories, and color or finish options unless special finish is specified. Indicate required modifications to standard products required for this installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product Manufacturers: KARP Associates, Inc., 888-629-3172.

B. Other Manufacturers: Submit substitution requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MANUFACTURED UNITS

A. Style and model as applicable to wall or ceiling finish.

1. KARP Model “KATR.”

B. ACCESS DOOR 1, Non-Rated Access Panels: Minimum 24-inches x 24-inches ceiling access panels and 18-inches x 18-inches wall access panels. All access panels shall open a minimum of 90 degrees. Minimum 24-inches x 24-inches for crawl access, larger sizes as detailed or suitable for maintenance access to concealed equipment and devices.

C. ACCESS DOOR 2, Non-Rated Toilet Room Wall Access Panels: 18-inches x 18-inches, Type 304 stainless steel, No.4 satin finish. Access panels shall open a minimum of 90 degrees.

D. Furnish cylinder locks to match brand and keyway design of cylinder locks specified in Division 8 Section Door Hardware. Fasten door panels to frames with continuous hinge, supply access doors and panels with factory-applied white rust-inhibitive prime coat.

E. Where required, access panels shall have surface weight equivalent to the surrounding construction and contain perimeter gasketing for an airtight seal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all panels in accordance with manufacturer's standard specifications and recommendations.

B. Verify that reinforcing, backing or blocking required for solid anchorage is in place. Furnish with screw type fasteners long enough to anchor into supports.

C. Furnish and install free from damage and in perfect operating condition.

END OF SECTION

SOUND-RATED AND SOUND-CONTROL DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish and install Sound-Rated and Sound-Control Doors specified herein and per the locations and orientations shown on the Contract Documents. Verify all dimensions and requirements and coordinate with other trades as necessary to complete the work on schedule.

B. The intent of this Specification is to insure that the sound isolation performance of Sound-Rated and Sound-Control Door assemblies meets or exceeds the requirements called for by the project Acoustics Consultant. This is to be achieved by the following: (1) specification of appropriate sound isolation criteria and door components by the project Acoustics Consultant; (2) selection and screening of products including certification of manufacturer's performance claims; (3) verification of sound isolation performance by tests conducted on installed assemblies using standardized field test procedures. If these tests indicate that sound isolation is below specified requirements, diagnostic procedures may be required to determine whether the unsatisfactory performance is caused by the Sound-Rated or Sound-Control Door assembly or the surrounding construction. In either event, the cause(s) must be determined and corrected.

C. These specifications establish straightforward and equitable procedures to diagnose and correct unsatisfactory sound isolation performance, if it occurs, while anticipating possible complications and assigning responsibilities appropriately.

D. These specifications are written to hold the manufacturer and the Installing Contractor responsible for the performance of their components and installation only. It is the responsibility of the Architect and the project Acoustics Consultant to design surrounding constructions which will prevent any sound paths which may flank the Sound-Rated and Sound-Control Door assemblies. It is the responsibility of the General Contractor and his Subcontractors to build the surrounding constructions in accordance with the Contract Documents.

1.2 RELATED SECTIONS

A. Section 08 11 14 - Hollow Metal Doors and Frames

B. Section 08 12 23 - Interior Aluminum Frames

C. Section 08 14 00 - Wood Doors

D. Section 08 41 13 - Aluminum Framed Storefronts

E. Section 08 71 00 - Door Hardware

1.3 REFERENCES

A. This work is subject to applicable portions of ASTM: American Society for Testing and Materials, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.

1. E90-04. Standard Test Method for Laboratory Measurement of Airborne Sound

Transmission Loss of Building Partitions and Elements.

2. E336-05. Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings.

3. E413-04. Classification for Rating Sound Insulation.

1.4 SYSTEM DESCRIPTIONS

A. Sound-Rated Doors: Pre-engineered and pre-assembled door and frame assemblies that are provided with laboratory-tested Sound Transmission Class (STC) ratings by the door manufacturer.

B. Sound-Control Doors: Door and frame systems built up by the General Contractor and his Subcontractors out of specified components. These door assemblies are assigned a Noise Isolation Class (NIC) rating by the project Acoustics Consultant which may be verified after door installation. Contractor has option to submit sound-rated door assemblies from pre-approved manufacturers for approval in lieu of built-up sound-control doors.

1.5 SUBMITTALS

A. Submit shop drawings, manufacturer’s data, and product performance certification in accordance with General Conditions.

B. Shop drawings:

1. Provide full size details of frames, door leaves, hinges, and sound gasket components.

2. Provide installation details applicable to the construction in which the Sound-Rated and Sound Control Doors and frames will be installed.

3. Indicate construction, sizes, thicknesses, reinforcing, anchoring, and finishes of all materials.

C. Manufacturer’s data:

1. Provide illustrations and descriptions of all frames, door leaves (including surface weights), seals, and hardware items which will be exposed on doors and frames for design review by Architect and project Acoustics Consultant.

2. Provide complete installation and adjustment information.

D. Certification of Sound-Rated Doors:

1. Provide certified laboratory test reports from an independent acoustics laboratory showing that a fully operating installation of the specific Sound-Rated Door assembly proposed for installation has been measured in accordance with ASTM E 90-04 and has met or exceeded the scheduled STC ratings. The test results shall be representative of the

performance of the proposed Sound-Rated Door assembly.

2. Provide written evidence of at least two acoustical field tests showing that comparable installations have been measured in excess of a Noise Isolation Class (NIC) which is not more than 3 points below the specified STC rating following the procedures set forth in ASTM E 336-05.

3. Provide certified laboratory test reports attesting that the Sound-Rated Door and frame conform to the specified and scheduled requirements for fire rating.

E. Notification of work completion:

1. After installation and prior to acceptance testing, provide a letter to the Architect and the project Acoustics Consultant, co-signed by the General Contractor's project representative, indicating that all Sound-Rated and Sound-Control Door assemblies have been installed and gaskets have been adjusted to form an airtight seal around the full perimeter of each door panel.

1.6 SEQUENCING AND DELIVERY

A. Upon award of contract and before commencement of building construction, submit to the Architect any special requirements (scheduling, flatness of floor, etc.) which are necessary to ensure successful installation.

B. Protect door systems during transit, handling and storage to prevent damage, soiling, and deterioration.

C. Deliver frames to General Contractor with complete installation drawings and instructions for installation by the General Contractor and/or his Subcontractor.

D. Deliver doors to project site only after the building has been closed in. Store doors in the building in a dry location and stack in accordance with manufacturer's instructions.

E. Protect door assemblies, especially sound gaskets, from damage before, during, and after their installation.

1.7 WARRANTY

A. Door assemblies shall be warranteed against defective workmanship, operation and materials for a period of two years from time of final acceptance.

1.8 COORDINATION

A. Sound-Rated and Sound-Control Doors require coordination with the work of other disciplines not described in this Specification. Coordination is especially required with.

1. Door hardware.

2. Fire ratings.

3. ADA requirements for door operating forces and threshold clearances.

4. Resilient wood subflooring and corridor elevations.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The door assemblies shall be configured as indicated on the Contract Documents.

B. The door hardware shall be sized to support the weight of the door and provide easy movement by one person.

C. The gasketing system shall provide an airtight seal around the entire perimeter of the door when closed. Effort to compress the seal shall not exceed ADA requirements.

2.2 SOUND-RATED DOOR TYPES

A. SRD-1S: STC 54. 3-1/2” thick, rabbeted metal swinging door with sound retardant core. Split rabbeted frame with dual magnetic head/jamb seals. Cam-lift hinges, Dual compression door bottoms seals. Smooth raised threshold. Noise Barriers QS-54-SL.

B. SRD-2p: STC 50. 2-1/2” thick, pair of rabbeted metal swinging doors with sound retardant core. Split rabbeted frame with dual magnetic head/jamb seals. Cam-lift hinges. Compression door bottom seal. Smooth flush sill condition. Noise Barriers QS-50-DL.

2.3 SOUND-CONTROL DOOR TYPES

A. SCD-1S: NIC 38. 1-3/4” thick, 6.5psf minimum, solid-core flush wood door or metal door with fiberglass insulation core. Metal frame with kerf-in head/jamb seals. Standard butt hinges. Sweep door bottom seal. Smooth raised threshold.

B. SCD-2P: NIC 36. Pair of 1-3/4” thick, 6.5psf minimum, solid-core flush wood doors or metal doors with fiberglass insulation core. Metal frame with kerf-in head/jamb seals. Cam-lift hinges. Sweep door bottom seals. Astragal/meeting stile seals. Smooth flush sill condition.

C. SCD-5S: NIC 34. 1-3/4” thick, 5psf minimum, solid-core flush wood door or metal door. Standard butt hinges. Hollow metal frame with kerf-in head/jamb seals. Sweep door bottom seal. Smooth raised threshold.

D. SCD-5P: NIC 32. Pair of 1-3/4” thick, 5psf minimum, solid-core flush wood doors or metal doors. Standard butt hinges. Hollow metal frame with kerf-in head/jamb seals. Sweep door bottom seals. Astragal/meeting stile seals. Smooth raised threshold.

2.4 APPROVED SOUND-RATED DOOR MANUFACTURERS (subject to the requirements of this

Specification)

A. Noise Barriers LLC. 1207 Remington Road, Suite E, Schaumburg, IL 60173. Tel 847-843-0500. Fax 847-843-0501. Website www.noisebarriers.com.

B. Industrial Acoustics Corporation. 1160 Commerce Avenue, Bronx, New York 10462-5599. Tel 718-931-8000. Fax 718-863-1138.Website www.industrialacoustics.com.

2.5 SOUND CONTROL DOOR COMPONENTS

A. Frames: Rabbeted metal frame with kerf to receive specified kerf-in head/jamb seals. Frames filled with mineral wool.

B. Cam-lift hinges: Stainless steel mortise hinge with cam action that lifts and lowers door with the swing. Zero 950.

C. Kerf-in head/jamb seals: Kerf-mounted silicone bubble seals. Pemko S52.

D. Sweep door bottom seal: Fixed thermo-plastic elastomer sweep seal mortised into door bottom at wood doors and surface-mounted beneath door bottom at metal doors. Pemko 234_PK at wood doors, Pemko 222_PK at metal doors.

E. Astragal/meeting stile seals: Adjustable silicone seal mortised into one door edge at wood doors and adjustable metal seal mortised into opposite door edge at wood doors. Adjustable silicone seal surface-mounted to one door face at metal doors and adjustable metal seal surface-mounted to opposite door face at metal doors. Pemko 354_S at wood doors, Pemko 351_S at metal doors.

F. Smooth raised threshold. Threshold with smooth surface that is raised above adjacent floor finishes.

G. Smooth flush sill condition: No threshold or threshold with smooth surface that is installed flush with adjacent floor finishes.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before commencing installation, examine the substrate and surrounding conditions to verify that there is nothing to prevent proper and timely execution of the installation. Start of work shall indicate acceptance of the substrate and surrounding conditions.

3.2 INSTALLATION

A. Install items plumb (or as indicated on the Contract Documents), straight, square, level, and in their proper elevation, plane and location.

B. At Sound-Control Door Assemblies, doors shall fit accurately within frames to properly engage all seals to form an airtight seal around the entire perimeter of the doors. Install doors to the following tolerances, measured with the door closed:

1. 1/8” between door edges and jambs.

2. 1/8” between door top and head. (3/16” if cam-lift hinges are used).

3. 3/16” between door face and stop.

4. 3/16” between door bottom and threshold.

5. 1/4” between center of door edges at pair of doors.

C. At Sound-Rated Door Assemblies, adjust all gaskets to achieve an airtight seal around the entire perimeter of each door panel according to the manufacturer’s guidelines.

D. Hollow metal frames at Sound-Rated Doors and Sound-Control Doors shall be filled with mineral wool.

E. Thresholds shall be firmly set in a bed of grout or mastic.

F. All work shall be complete in every detail and the finished work shall be clean for the Architect prior to final acceptance.

3.3 ACCEPTANCE TESTING

A. Before acceptance of the installed Sound-Rated and Sound-Control assemblies, and at any time within the project guaranteed period, the Owner or Architect may request that acoustical performance testing of the installations be performed. Expenses for the project Acoustics Consultant to perform this testing shall be paid by the Installing Contractor.

B. Sound-Rated Door installations shall be deemed acceptable if the assemblies meet or exceed a Noise Isolation Class (NIC) which is not more than 3 points below the specified Sound Transmission Class (STC) rating. Sound-Control Door installations shall be deemed acceptable if the assemblies meet or exceed a Noise Isolation Class (NIC) which is equal to the specified NIC rating. Measurements are to be conducted in accordance with procedures set forth in ASTM E 336-05 with the following exceptions and additions:

1. This test is intended to measure the performance of a Sound-Rated or Sound-Control Door assembly and it is, therefore, important that microphone positions be selected to obtain data for sound transmission through that assembly. For this test, microphone positions may be as little as 0.5 m (approx. 1'-8") apart.

C. Failure to meet or exceed the required field test may require the following procedures to be followed:

1. Gaskets shall be scanned while a broad-band noise source (as described in ASTM

E336-05) is operating on the opposite side. If necessary, the gaskets shall be Contractor-adjusted so that A-scale values at 6 inches from the gaskets are not more than 4 dB(A) greater than A-scale values measured 6 inches away from the center of the door.

2. If all the perimeter gaskets pass or are adjusted to pass the above scanning test and the specified NIC value is still not achieved, the Architect or the Owner may request that flanking checks be made. The check may involve taping of all gasketed joints using a special adhesive tape designated by the project Acoustics Consultant.

3. If the taped assembly achieves the specified NIC value, the Installing Contractor shall be responsible for the cost of taping and whatever additional adjustments, modifications and tests are necessary to meet the specified NIC value for the fully operating assembly.

4. If the taped assembly does not yield the specified NIC value, then flanking, panel deficiency, or both may be responsible. If, by the judgment of the project Acoustics Consultant, there is no unequivocal indication whether flanking or panel deficiency is the probable cause, then checks for flanking transmission using a supplemental panel barrier (as described in ASTM E 336-05, Annex A1) will be conducted.

5. If flanking transmission is revealed by these checks, then the Architect, Owner, project Acoustics Consultant, and General Contractor shall determine appropriate corrective measures to eliminate the flanking paths and responsibilities for both corrections and costs of testing and retesting. The surrounding construction shall be deemed satisfactory when the specified NIC value has been met with the supplemental panel barrier in place.

6. If the specified NIC value is no longer met after removing the supplemental panel barrier, then door panel deficiencies and/or some other fault directly associated with the door assembly are indicated as the cause of unsatisfactory performance. The Installing Contractor shall be responsible for accomplishing modifications and subsequent retesting until the operating assemblies perform as specified.

7. If the door assembly in question is so large that these procedures are unreasonably difficult or extraordinarily costly, then the Architect, Owner, project Acoustics Consultant, and General Contractor shall determine appropriate alternative procedures.

END OF SECTION

ALUMINUM FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all material, equipment, labor and services necessary for the installation of extruded aluminum entrances and storefronts. Include all aluminum brake shape covers, connectors, and trim.

B. Related Sections:

1. Division 7 Section "Joint Sealants."

2. Division 8 Section "Door Hardware."

3. Division 8 Section "Glazing."

4. Division 8 Sections "Sound-Rated and Sound-Control Doors" and "Sound-Control Windows."

1.2 REFERENCES

A. Aluminum Association Standards (AA).

B. American Architectural Manufacturers Association (AAMA).

C. American Society for Testing and Materials (ASTM).

D. International Building Code (IBC).

1.3 PERFORMANCE REQUIREMENTS

A. Storefront System:

1. Air infiltration shall not exceed 0.060 cfm/s.f. of fixed area at 6.24 psf pressure when tested in accordance with ASTM E283.

2. Water penetration shall not occur when tested in accordance with ASTM E331 at a static test pressure of 10 psf as defined in AAMA 501.

3. Uniform Load: A static air design load of 20 psf (958 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

4. Thermal Performance: Mullion and perimeter gutters shall be separated from mullion and perimeter faces by a special designed clip, eliminating all metal to metal contact between exterior and interior of the frame. Performance shall be such that condensation will appear on the interior surface of 1-inch insulated glass before on the metal.

Maximum U-value of 0.45 and minimum CRF value of 60 when tested in accordance with AAMA 1503.

B. Doors:

1. Corner racking resistance test to be a Dual Moment Load test. The test section shall withstand a load of 170 lbs. on lever arm before reaching point of 1/16-inch gap at stile/rail or 3-degree rotation in the stile, and the lever arm shall not rotate in excess of 45-degree prior to 309 lb. load.

2. Air infiltration shall not exceed 0.50 cfm per lineal foot of crack when tested in accordance with ASTM E283 at pressure differential of 6.24 psf for single doors and 1.0 cfm per linear foot of crack for pairs of doors.

C. Storefornt system reinforcing shall be designed by the storefront manufacturer in accordance with the IBC and other codes of the governing jurisdiction. Shop drawings shall be stamped with the seal of a registered engineer licensed to practice in the State of Oregon.

1.4 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings, stamped by a structural engineer registered in the State of Oregon. The submittal shall include calculations for store front frame sections, glazing and anchorage to withstand such forces as seismic and wind loading.

C. Shop drawings for each aluminum entrance, and storefront system required, including:

1. Layout and installation details, including relationship to adjacent work.

2. Elevations at 1/4-inch scale.

3. Detail sections of typical composite members.

4. Anchors and reinforcement.

5. Hardware mounting heights.

6. Provisions for expansion and contraction.

7. Glazing details.

D. Product data for each window, aluminum entrance, and storefront system required including:

1. Manufacturer’s standard details and fabrication methods.

2. Data on finishing, hardware and accessories.

3. Recommendations for maintenance and cleaning of exterior surfaces.

E. Complete hardware schedule organized into sets based on hardware specified. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Include item name, name of the manufacturer and complete designations of every item required for each door opening.

F. Pairs of samples of each specified color and finish on 12-inch long sections of extrusions or formed shapes. Where normal color variations are anticipated, include two or more units in each set of samples indicating extreme limits of color variations.

G. Certified test reports from a qualified independent testing laboratory showing that aluminum windows, entrances, and storefront systems have been tested in accordance with specified test procedures and comply with performance characteristics indicated.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacture of aluminum storefront systems with a minimum of ten years' experience, with work of similar type and scope.

B. Proposer: Company acceptable to the Architect and storefront system manufacturer, specializing in contracting installation of total storefront systems of similar type and scope.

C. System Designer: Manufacturer or manufacturer-authorized.

D. Installer: Authorized by the system manufacturer. Installation shall be performed by skilled workers, especially trained and experienced in the applicable trades employed. Single installer for aluminum framed storefront systems.

E. General Requirements: All work, material, design, and installation shall be in accordance with the best industry practices as set forth in:

1. AAMA Metal Curtain Wall, Window, Storefront and Entrance Guide Specifications Manual.

2. FGMA Glazing Manual.

F. Regulatory Agency: Comply with the IBC and the requirements of all other governing agencies.

G. Pre-Construction Conference: Schedule prior to commencement of erection of first components of storefront system.

1. Attendance:

a. Owner.

b. Contractor.

c. Storefront manufacturer.

d. Architect.

e. Structural engineer.

f. Installer of each major system.

g. Sealant subcontractor who will be responsible for storefront sealing.

2. Agenda:

a. Sequence of delivery.

b. Storage.

c. Sequence of installation.

d. Requirements for coordination with other trades.

e. Hoisting procedures.

f. Verification of sealant compatibility.

g. Environmental conditions.

1.6 WARRANTY

A. Provide from storefront system fabricator and installer, a written warranty covering materials and workmanship in accordance with Division 1 Section "Closeout Procedures." Warranty that the system will perform as specified and as follows:

1. That sealed joints shall remain watertight and free of crazing, surface degradation, adhesive or cohesive failure, chalking, staining of adjacent materials by sealant or primer, and change in hardness, for a period of three years.

2. That coated surfaces will remain protected against corrosion or a period of five years.

3. That installed system will remain free from water penetration to the building interior, and will perform as specified, without failure, for a period of five years.

4. Deliver warranties to the Owner in duplicate, in an acceptable form, executed by an authorized officer of the manufacturer of each material, dated and notarized.

B. Warranty Extension: Failure in any of the storefront system components shall result in an extension of the warranty period until the deficiency is corrected. The Contractor shall be responsible for continuing corrections to defective work beyond the warranty period if initial corrective measures are later found to be inadequate or not acceptable after the specified warranty period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Storefronts: "Trifab VG 451T" thermally broken framing system by Kawneer Co.

B. Aluminum Doors and Frames: "500 Tuffline" by Kawneer Co.

C. Other Products: As described below.

D. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Framing members of extruded aluminum sections formed of ASTM B221, 6063-T5 alloy and temper. Members true to detail and free from defects impairing appearance, strength or durability.

B. Exposed brake shape sheet aluminum of minimum 0.060-inch thick, ASTM B209, 5005-H34 alloy and temper. Brake formed to dimensions and profiles as detailed, with straight and sharply defined profiles and arises. Provide returns and end closures for members wherever necessary.

C. Continuous run joints centered on intersecting vertical or horizontal members and at other approved braking points. Back-up butted joints in continuous runs with concealed tongue and clip. Design for fully concealed fastenings.

D. Exposed fasteners of aluminum or stainless steel. Concealed fasteners may be cadmium or zinc plated steel in accordance with ASTM B766 and ASTM B633.

E. Cold-rolled steel conforming to ASTM A283, Grade C, bonderized and prime painted. All steel members must be properly insulated from aluminum contact.

F. Single acting entrance frame weatherstripping of nonporous polymeric material.

2.3 FABRICATION

A. Wall components of factory-fabricated parts and assemblies designed for job site erection with a minimum of field labor. Design system to provide for expansion and contraction through an ambient temperature range of 120ºF without buckling or opening of joints.

B. Sound Rated Assemblies: Clearance at frames for sound-control doors and sound-control windows shall be in accordance with Division 8 Sections “Sound-Rated and Sound-Control Doors” and “Sound-Control Windows.”

C. Vertical and horizontal members 2-inch face width by 4-1/2-inch deep and accommodating infill with edge thickness 1-inch. Nominal glazing edge depth 1/2-inch.

D. Glazing Materials: Resilient EPDM elastomers field-installed under pressure providing high performance weathering. Horizontal members provided with weeps to the exterior to control moisture entering the system. Mullions on horizontal rails have flexible thermal break material located on exterior side of glass plane.

E. Finish: All exposed grid framing members, aluminum fasteners and brake shape sheet aluminum free of scratches and surface blemishes and given an AAMA 611 Architectural Class I clear anodized coating conforming to AA-M12C22A41.

F. Entrance Doors:

1. All door stiles and rails fabricated from 6063-T5 alloy and temper aluminum 0.188-inch wall thickness.

2. Door frame face dimension 5-inches on vertical stiles, 6-inches on top rail, bottom rail 10-inches, and frame 2-inches deep. Corner construction shall be mechanical clip fastening, SIGMA deep penetration and fillet welds, hook-in type glazing stops with EPDM glazing gaskets. Weatherstripping consisting of thermoplastic elastomer type in tubular stop with semi-rigid polymeric backing.

3. All members cut and fitted accurately with hairline joints. Make all cut-outs, recessed mortises, and do all milling to receive hardware with precision. Provide all reinforcing for hardware installation at factory. Door manufacturer will be furnished with finish hardware listed in the hardware schedule by hardware supplier for installation.

G. Sealant:

1. In matching color; see Division 7 Section "Joint Sealants."

2. Manufacturers:

a. Dow "795."

b. G.E. "Silpruf Silicone 2000."

PART 3 EXECUTION

3.1 INSTALLATION

A. Set all members accurate to line and detail, aligned with building lines using approved fastenings and anchors to supporting structures. Use concealed mechanical fastenings and screws to make joints and assemble sash and frame systems. No visible screws or rivets without specific approval.

B. Design for no joints on continuous members wherever practical, except for expansion joints where required. Make necessary joints centered on intersecting framing or other regular breaking point as approved. Provide concealed shims to align face surfaces of all members of similar type.

C. Seal all joints in system and at perimeters to prevent infiltration and entry of water. Protect aluminum from galvanic attack where in contact with dissimilar metals by approved paints or tape.

D. Install exit devices and strikes and fit lock cylinders specified in Division 8 Section "Door Hardware," center cylinders as detailed. Make all adjustments to fit of doors after hardware installation and glazing. Install push-pull hardware and stops as scheduled.

3.2 ADJUSTING AND CLEANING

A. Debris caused by or incidental to the installation of work of this Section shall be removed from the site daily, as work progresses.

B. Clean weep holes and drainage channels free of obstructions and sealants. Remove all dirt and debris prior to closing up concealed gutters and channels.

C. Adjust operating hardware to operate smoothly and fit tightly when closed and locked, and be properly aligned with frames.

3.3 PROTECTION

A. Protect aluminum finishes during installation, glazing and after erection from stains, scratches, and other finish damage. Thoroughly clean all aluminum surfaces using approved wax cleaners, soap and water. Do not use abrasives, strong alkaline or acid cleaners on aluminum. Protection from subsequent work and final cleaning as specified in Division 1.

END OF SECTION

TRANSLUCENT ROOF ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, and equipment required for the installation of fixed curb mount skylights and engineered flashings on site built curbs.

1.2 DEFINITIONS

A. Permanent Deformation: Deflection without recovery exceeding 1/240 of span.

B. Water Leakage: Appearance of uncontrolled water, other than condensation, on translucent roof systems inboard parts.

C. Excessive Fading: Change in appearance which is perceptible and objectionable as determined by Architect when viewed visually in comparison with original color range standards.

D. Excessive Non-Uniformity of Color or Shade: Non-uniform fading during warranty period to extent adjacent panels have color difference greater than original acceptance color range.

E. Cracking, Peeling, Pitting or Corroding: Such defect discernible from distance of 10 feet.

1.3 SYSTEM DESCRIPTION

A. Basis of Design:

1. Manufacturer: Kalwall Corporation.

2. Product: 2-3/4-inch Insulated Translucent Roof Panel System, S-Lines. Units are curb ready, with factory sealed aluminum perimeters.

a. Light Transmittance: 22%

(1) Exterior Face: Crystal.

(2) Interior Face: Crystal.

B. Performance Requirements:

1. Fire Performance: Translucent panel must be acceptable as a Non-Combustible material in compliance with IBC Chapter 703.4.2. Exterior and interior face sheets must be listed by Underwriters Laboratories with Flamespread no greater than 50 in accordance with UL-723/ASTM E-84/UBC 8-1.

2. Exterior Color Stability: Color stability of exterior face sheet must be documented by independent testing on project-specific materials weathered outdoors in South Florida for a minimum of five (5) years.

3. Deflections: Design, fabricate and install component parts so deflections normal to any plane at full loading will not exceed 1/240 of component parts clear span with maximum deflection not greater than 1 inch. Base calculations for such deflections upon combination of maximum direct loadings, building deflections, thermal stresses, and erection tolerances. Do not permit permanent deflections in translucent roof panel work.

4. Thermal Movement: Design, fabricate, and install translucent roof panels to withstand expansion and contraction forces resulting from ambient temperature range of 120 degrees Fahrenheit.

5. Water Leakage: Design, fabricate, and install translucent roof panels including joints and flashings between translucent roof system and other work to effectively prevent water leakage into building.

6. Condensation: Design, fabricate, and install translucent roof system to drain all moisture in the system to the sill for a controlled discharge to exterior.

7. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of area, measured at a reference differential pressure across assembly of 12.0 psf as measured in accordance with ASTM E 283.

8. Water Leakage: None, when measured in accordance with ASTM E 331 at a test pressure difference of 12.0 lb/sq ft.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Submittal Procedures.

B. Product Data: Manufacturer’s specifications and installation instructions for components required in system. Include system design calculations or recognized test data, materials certifications and other data required to show compliance with these specifications.

C. Shop Drawings: Indicate complete installation including glazing. Show typical details of conditions at not less than 3" = 1'-0" for every member, joint, anchorage and glazing system. Assemble shop drawings of principal component parts into submittal and prepare coordination details and erection diagrams for whole system.

1. Engineering Calculations: Provide calculations by manufacturer and reviewed by structural engineer registered in Oregon, substantiating maximum deflection does not exceed specified performance requirements under full design loading.

D. Samples:

1. Each finish specified, on aluminum having specified alloy, temper, and thickness of metal required for work. Provide two (2) 5 inch lengths for extrusions and 2 inch squares for sheet or plate, showing maximum range or variation in color and shade.

2. Each type of panel specified: provide two (2) 14 inch by 28 inch panel samples.

E. Test Reports: Submit test reports from a qualified independent testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.

1. Flame Spread and Smoke Developed (UL 723). Submit UL Card on both exterior and interior face sheet.

2. Burn Extent (ASTM D 635)

3. Color Difference on Outdoor Weathered Faces (ASTM D-2244)

4. Abrasion / Erosion (ASTM D-1040)

5. Impact Strength (UL 972)

6. Bond Tensile Strength (ASTM C-297 after aging by ASTM D-1037)

7. Bond Shear Strength (ASTM D-1002)

8. Beam Bending Strength (ASTM E-72)

9. Insulation U-Factor (NFRC-100)

10. NFRC System Certification.

11. International Code Conference (ICC-ES) approval for face sheets used on this project.

12. Water Infiltration (ASTM E-331)

13. Air Infiltration (ASTM E-283)

14. Structural Testing (ASTM E-330)

F. Maintenance Manual: Describe materials, devices and procedures to be used in cleaning and maintaining translucent roof systems. Include manufacturers' brochures describing actual materials used in work, including metal alloys, finishes, glass, sealants, gaskets and other major components.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Materials and products are to be manufactured by a company continuously and regularly employed in the manufacture of specified materials for at least 10 consecutive years which can show evidence of those materials being satisfactorily used on at least six (6) projects of size, scope and location. At least three (3) of these projects must have been in successful use for a minimum of ten (10) years.

2. Panel system used for this project must be listed by the International Code Conference – Evaluation Service (ICC-ES) which requires quality control inspections and fire, structural and water infiltration testing of panels by an approved agency.

3. Quality control inspections and required testing to be conducted at minimum once per year including manufacturer facilities, sandwich panel components and production panels for conformance with "Acceptance Criteria for Sandwich Panels" as regulated by the ICC-ES.

B. Installer Qualifications: Installation is to be performed by an experienced installer, which has been in the business of installing specified panel systems for a minimum of ten (10) consecutive years and can show evidence of satisfactory completion of projects of similar scope and type:

C. Pre-Installation Conference: Prior to commencement of metal-framed translucent roof system work, schedule meeting at mutually agreeable time to include Owner, Architect, Contractor, Contractor's field superintendent, translucent roof system contractor, and other interested parties to review methods and procedures to be used to achieve end results.

1.6 DELIVERY AND STORAGE

A. Delivery: Deliver fabricated units and component parts to project site identified in accordance with erection diagrams prepared by firm awarded translucent roof system work.

B. Storage: Store under cover in accordance with manufacturer's instructions, in a trailer or above grade on dunnage, properly protected from weather and construction activities.

1.7 PROJECT CONDITIONS

A. Environmental Requirements: Do not install materials when temperature is below minimum recommended by manufacturers. Do not install sealants when substrate materials are wet, or in extreme temperature conditions or when heavy winds are predicted during initial cure period.

1.8 WARRANTY

A. Translucent Wall Panel Work: Submit written warranty for period of 5 years, signed by Contractor and Translucent roof system Contractor, agreeing to repair or replace defective materials or workmanship.

1. Defective materials and workmanship is hereby defined to include evidence of early deterioration, weathering or aging of work outside of the specified tolerances, uncontrolled water penetration, or air infiltration, and other evidence of deterioration or failure of work to comply with performance or other requirements.

2. Repair work required because of acts of nature (which exceed performance requirements), alterations, abuse, vandalism, failure of supporting structure and other causes beyond Contractor's fault will be paid by Owner at prevailing rates.

B. Translucent Roof Panel Materials: Submit manufacturer's written limited warranty for period of 5 years, signed by translucent roof system Manufacturer, agreeing to repair or replace defective materials.

1. Defective materials is hereby defined to include evidence of separation of the faces from the grid core; reinforcing fiber exposure and/or abnormal color change of the face.

C. Finish Warranty: Warrant against excessive fading, excessive non-uniformity of color or shade, cracking, peeling (within limits defined) for period of 5 years.

D. Upon notification of defects within warranty period, make necessary repairs and replacements at Owner's convenience.

PART 2 PRODUCTS

2.1 PANEL COMPONENTS

A. Face Sheets:

1. Translucent Faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.

a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.

2. Flammability of Interior Face Sheet:

a. Flamespread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting. Flamespread rating no greater than 20 and smoke developed no greater than 200 when tested in accordance with UL 723.

b. Burn extent by ASTM D-635 shall be no greater than 1."

c. Face sheets shall not deform, deflect or drip when subjected to fire or flame.

d. Face sheets shall not delaminate when exposed to 200°F for 30 minutes per IBC.

3. Weatherability of Exterior Face Sheets:

a. Color Stability: Full thickness of the exterior face sheet shall not change color more than 3.0 DELTA E Units by ASTM D-2244 after 5 years outdoor South Florida weathering at 5 degrees facing south, determined by the average of at least three (3) readings on samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.

b. Erosion Barrier: Exterior face shall have a permanent glass erosion barrier embedded beneath the surface to provide long-term resistance to reinforcing

fiber exposure. Sacrificial surface films or coatings are not acceptable erosion barriers.

c. Abrasion Resistance: Exterior face surface loss shall not exceed 0.7 mils and 40 mgs when tested in accordance with ASTM D-4060 employing CS17 abrasive wheels at a head load of 500 grams for 1000 cycles.

4. Appearance:

a. Exterior face sheets: Smooth, 0.070" thick and crystal in color. Type SWC.

b. Interior face sheets: Smooth, 0.045" thick and crystal in color. Type 25.

c. Face sheets shall not vary more than +/- 10% in thickness and be uniform in color.

5. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact equal to 70 (230) ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972.

B. Grid Core: Aluminum I-beam grid core of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I- beam shall be no less than 7/16." The I-beam grid shall be machined to tolerances of not greater than +/- .002 inch.

C. Laminate Adhesive:

1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives".

2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C-297 after two (2) exposures to six (6) cycles each of the aging conditions prescribed by ASTM D-1037.

3. Minimum shear strength of the panel adhesive by ASTM D-1002 after exposure to five (5) separate conditions:

a. 50% Relative Humidity at 73° F: 540 PSI.

b. 182° F: 100 PSI.

c. Accelerated Aging by ASTM D-1037 at room temperature: 800 PSI.

d. Accelerated Aging by ASTM D-1037 at 182° F: 250 PSI.

e. 500 Hour Oxygen Bomb by ASTM D-572: 1400 PSI.

2.2 BATTENS AND PERIMETER CLOSURE SYSTEM

A. Aluminum Extruded Closure System: 6063 T6 and 6063-T5 alloy and temper two-piece batten and perimeter system that is suitable for specified finish.

B. Fasteners: Exposed fasteners used for attachment of exterior and interior caps, fillers and trim shall be Series 300 stainless steel, color to match adjacent surfaces. Fasteners used for bolting aluminum extrusions and connecting members shall be as recommended by translucent roof system manufacturer. Fasteners for translucent wall system attachment to supporting structure shall be as engineered and recommended by translucent roof system manufacturer.

C. Aluminum Angles, Plates, Bars, Rods and Other Aluminum Accessories: Alloys recommended by manufacturer.

D. Flashing: Preformed aluminum minimum .040 inch thick, as required to maintain flatness in size and configuration required, finished to match translucent roof system.

2.3 FINISHES

A. Aluminum Finishes: Remove scratches, abrasions, dents, die markings and similar defects prior to finishing operations. Perform this work in addition to finish treatment specified. Scratches, abrasions, dents and similar defects are unacceptable.

1. Exposed aluminum finish to be manufacturer’s standard factory-applied coating that meets or exceeds the performance requirements of AAMA 2605. Color to be Aluminum No. 79.

2.4 FABRICATION

A. Complete factory cutting, drilling and fitting of specified materials prior to shipment to jobsite.

B. Welding where required with electrodes and methods recommended by aluminum manufacturer in accordance with applicable recommendations of AWS. Grind weld areas smooth and restore mechanical finish condition before proceeding with other treatment.

C. Carefully fit and match work with factory-applied interior closure tabs and seals to accomplish continuity of moisture barrier on interior battens.

D. Separate dissimilar metals or alloys with 10-mil vinyl tape applied to dry materials to prevent galvanic action.

E. Insofar as practicable, fit and assemble work in manufacturer’s shop. Work which cannot be permanently shop assembled before shipment shall be assembled, marked and disassembled before shipment to job site to assure proper assembly in field.

F. Fabricate battens caps with countersunk holes and factory-apply sealing gasket under controlled conditions.

G. Attach all components using stainless steel fasteners.

H. Form attachment clips of aluminum as engineered and finish to match framing.

I. Provide setting blocks and side blocks for panel support in size and location in accordance with panel manufacturer's recommendations.

J. Provide weep holes located at lowest portion of extruded aluminum sill at each batten connection for drainage of condensation to exterior. Custom shape and size weep holes shall match weep holes of existing translucent panels.

PART 3 EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Examine substrates, adjoining construction and conditions under which work is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Field Measurements: Verify dimensions before proceeding with Work. Obtain field measurements for work required to be accurately fitted to other construction. Be responsible for accuracy of such measurements and precise fitting and assembly of finished Work.

B. Preparation of Surfaces for Sealants: Clean panels and aluminum surfaces as recommended by sealant manufacturer. Remove protective coatings which might interfere with sealant's bond. Prime surfaces to be sealed if required. Tool sealant joints smooth with no sealant left on exposed panel surface.

3.3 INSTALLATION

A. Erect and glaze translucent roof system in accordance with translucent wall system manufacturer's instructions and with final approved shop drawings.

B. Coordinate translucent roof system work with contiguous Work and provide components at proper time to avoid delays in Work. Place such items, including inserts and anchors, accurately in relation to final location of translucent roof system components.

C. Cut battens, caps and perimeter closures for field fit and form flashings for watertight installation.

D. Do not erect components that are warped, bowed, deformed or otherwise damaged. Remove and replace damaged members.

E. Isolate dissimilar materials with separation in accordance with manufacturer's recommendations.

F. Inspect panels before installation. Verify insulation is properly installed. Do not install improperly sized materials, panels with damaged edges, scratches, abrasions or any materials that are otherwise damaged. Remove labels from panels after installation.

G. Set panel system in manner which produces greatest possible degree of uniformity in appearance.

H. Install translucent panel system to be watertight, airtight, and capable of withstanding temperature changes and wind loading without failure.

I. Provide self-healing membrane at locations where fasteners penetrate system components in water path.

J. Perimeter Weather Seal: Install backer rod and perimeter sealant in accordance with manufacturer's instructions; width indicated, or if not indicated minimum 1/2 inch or as required to provide weatherproofing.

3.4 FIELD QUALITY CONTROL

A. Water Penetration Test: After installation completion of area designated by Architect, and nominal curing of sealants and glazing compounds, Owner will employ an independent agency to test translucent roof system for water leaks in accordance with AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls for Water Leakage. Conduct tests in Architect's presence. Correct deficiencies resulting from test.

3.5 ADJUSTING AND CLEANING

A. Clean excess sealant or compound from panels and framing members using manufacturer's recommended solvents or cleaners.

B. Remove and replace materials during construction period which are broken, cracked, chipped or damaged in any way and from any source, including weather, vandalism or accidents.

3.6 PROTECTION

A. Protect translucent roof systems from damage during construction period so they will be without damage at time of Substantial Completion.

END OF SECTION

REINFORCED VINYL WINDOWS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, and equipment required for the installation of fabricated reinforced tubular extruded vinyl windows with fixed and operating sash, including factory glazing, operating hardware, insect screens, and perimeter sealant.

1.2 PERFORMANCE REQUIREMENTS

A. Window framing and glass structurally designed to 2014 IBC.

B. Windows have been tested in accordance to AAMA/WDMA/CSA 101/I.S.2/A440-08,NAFS – North American Fenestration Standard / Specification for windows, doors and skylights and CSA A440S1-09.

C. Project performance requirements: Provide a system that complies with the performance requirements indicated, as demonstrated by certified laboratory testing.

1. Laboratory testing for water tightness to 15 PSF (720 Pa)..

2. Field testing for water tightness to 2/3 of laboratory test pressure when tested to ASTM E 1105-00 (CYCLED).

3. Operable windows to be equipped with Continuous Center Seal Technology employing a center seal system.

4. Structural performance of window mullions and couplers: maximum deflection of L/175 at design wind pressure.

5. Wind Loads: Windows and doors shall meet wind pressure loads in accordance with local building codes.

6. Thermal Movement: Allow for thermal movement without causing buckling stresses on glass, joint seal failure, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or detrimental effects.

7. Thermal Performance: Tested in accordance with NFRC 100, 200, & 500. Typical insulated double glazed unit is 1” (25mm) thick, includes ENDURE™ Warm Edge Spacer Bar, Preserve Protective Film on the #1 and #4 surfaces of IGU unit.

8. Performance Values for typical Insulated Glazing (comprised of Cardinal 4mm LowE270/ARG/ 4mm Clear), including window frame, are as following:

		Picture Window	Tilt before Turn Window
a.	“U” Value	0.26	0.26
b.	“SHGC” Value	0.28	0.26

c.	“VT” Value	0.54	0.48
d.	“CR” Value	65	63

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product Data: Manufacturer's product specifications, technical support data, installation and maintenance recommendations and standard details for each type of unit required, including finishing methods, hardware, and accessories:

1. Fixed window.

2. Multipoint locking dual action window.

C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, accessories, and finish colors.

D. Samples: Submit verification samples for white and colored uPVC as proposed.

E. Quality Assurance/Control Submittals:

1. Test Reports: Provide documentation showing compliance with specified performance characteristics and physical properties.

2. Installer Qualifications: Installation contractor to provide list of completed projects to demonstrate experience in the installation of High Performance uPVC Multipoint Locking Windows.

F. Closeout Submittals:

1. Warranty: Submit warranty documents specified herein.

2. Project Record Documents: Submit project record documents for installed materials in accordance with Division 1 Section “Project Record Documents.”

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installer Qualifications: Installer must have demonstrated experience installing High Performance uPVC Multipoint Locking Windows to at least three commercial projects for at least three consecutive years.

2. Manufacturer Qualifications: Manufacturer with production facilities located in North America, specializing in the fabrication of High Performance uPVC Multipoint Locking Window System for at least 10 years and actively participating in a third party quality

assurance/auditing program. Manufacturer capable of providing system application and fabrication expertise.

B. Mockup:

1. Provide sample installation for field testing window performance requirements and to determine acceptability of window installation methods.

2. Approved mockup shall represent minimum quality required for the Work.

3. Approved mockup may remain in place within the Work.

C. Pre-Installation Meeting: Manufacturer's authorized representative to conduct installer orientation and training session on correct product installation, handling, and hardware adjustment techniques.

1.5 PROJECT CONDITIONS / SITE CONDITIONS

A. Contractor to verify and confirm dimensions on shop drawings.

1.6 WARRANTY

A. Project Warranty: Refer to “Conditions of the Contract” for project warranty provisions.

B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document.

1. Beneficiary: Issue warranty in the legal name of the project Owner.

2. Warranty Period: As per manufacturer’s standard warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product Manufacturer:

1. Windows: Defender 76 TS High-Performance Multipoint Locking Window System as Manufactured and Distributed by Innotech Windows + Doors Inc., 604- 854-1111.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Extrusions: Galvanized steel framing integrally fastened to high Impact-modified, multi-chamber, un-plasticized PVC profiles. Outer wall extrusion thickness to be 2.7 mm (1/8”) minimum.

B. Hardware: Multipoint locking hardware of sufficient strength and appropriate finish to perform its intended function.

C. Glazing and weather-stripping: Triple gasket system on operable windows with heavy-duty center seal gasket. Manufacturer's standard setting blocks and spacers.

D. Installation Anchors:

1. Head and Sill: 13 gauge galvanized steel strap anchors.

2. Sill: 1-1/2” X 1-1/2” 18 gauge galvanized steel L-angle.

E. Insulated Glazing Units: Cardinal Low-E 270, argon filled.

2.3 FABRICATION

A. Shop Assembly: Fabricate framing and sash members with mitered, fusion welded corners.

1. Vertical mullions welded to frame at top and bottom where possible. Horizontal mullions connected to frame with mechanical connectors.

2. Trim and clean weld seam inside and outside of each corner joint for proper function of gaskets and hardware.

3. Provide pressure equalized rain screen water management system at fixed glazing and at sashes.

4. Provide sufficient vent holes to sealed cavities to prevent unwanted pressure build-up.

2.4 FINISHES AND COLORS

A. Manufacturer's standard solid homogenous uPVC finish, color Charcoal Black.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer’s installation guidelines, shop drawings, and pre-installation orientation and training guidelines.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify that substrate conditions are acceptable for product installation in accordance with shop drawings and manufacturer's installation guidelines.

3.3 PREPARATION

A. Do not begin installation until other work to be coordinated in conjunction with the installation is completed as required.

B. Protect adjacent work areas and finish surfaces from damage during product installation.

3.4 INSTALLATION

A. Install window frames, hardware, operators, accessories and other components according to manufacturer's installation guidelines, shop drawings, and pre-installation orientation and training guidelines.

B. Install frames square, level and plumb.

C. Anchor frames in accordance with manufacturer's installation guidelines and/or shop drawings.

D. Coordinate installation with wall flashings and other components of the work.

E. Adjust operating sash and hardware for proper operation and to provide tight fit at contact points and weather-stripping. Remove and reinstall units that do not operate properly because they were not installed square, level and plumb.

F. Seal frame perimeter as shown in the relevant Drawings.

3.5 FIELD QUALITY CONTROL

A. Field Test: Conduct field test if required by Owner/Architect to determine water tightness of window system. The Owner will pay the costs for field test. Field test to be performed in accordance to ASTM E 1105-00 (CYCLED), after test frame has been adjusted, cleaned and lubricated according to manufacturer's testing guidelines. Water penetration resistance tests shall be conducted at a static pressure equal to 2/3 (0.667) of the test pressure specified for the applicable product designation.

3.6 ADJUSTING, CLEANING AND PROTECTION

A. Adjusting: Adjust operating items for smooth operation.

B. Lubrication: Lubricate hardware and moving components after cleaning.

C. Cleaning: The General Contractor shall clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance, and remove construction debris from project site.

D. Protection: The General Contactor shall protect installed product's finish surfaces from damage during construction.

END OF SECTION

SOUND-CONTROL WINDOWS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish and install Sound-Control Windows specified herein and per the locations and orientations shown on the Contract Documents. Verify all dimensions and requirements and coordinate with other trades as necessary to complete the work on schedule.

B. The intent of this Specification is to insure that the sound isolation performance of Sound-Control Window assemblies meets or exceeds the requirements called for by the project Acoustics Consultant. This is to be achieved by the following: (1) specification of appropriate sound isolation criteria and window components by the project Acoustics Consultant; (2) selection and screening of products including certification of manufacturer's performance claims; (3) verification of sound isolation performance by tests conducted on installed assemblies using standardized field test procedures. If these tests indicate that sound isolation is below specified requirements, diagnostic procedures may be required to determine whether the unsatisfactory performance is caused by the Sound-Control Window assembly or the surrounding construction. In either event, the cause(s) must be determined and corrected.

C. These specifications establish straightforward and equitable procedures to diagnose and correct unsatisfactory sound isolation performance, if it occurs, while anticipating possible complications and assigning responsibilities appropriately.

D. These specifications are written to hold the manufacturer and the Installing Contractor responsible for the performance of their components and installation only. It is the responsibility of the Architect and project Acoustics Consultant to design surrounding constructions which will prevent any sound paths which may flank the Sound-Control Window assemblies. It is the responsibility of the General Contractor and his Subcontractors to build the surrounding constructions in accordance with the Contract Documents.

1.2 RELATED SECTIONS

A. Section 08 51 00 - Metal Windows

B. Section 08 80 00 – Glazing

1.3 REFERENCES

A. This work is subject to applicable portions of ASTM: American Society for Testing and Materials, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.

1. E90-04. Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

2. E336-05. Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings.

3. E413-04. Classification for Rating Sound Insulation.

4. E966 – 04. Standard Guide for Field Measurements of Airborne Sound Insulation of Building Facades and Façade Elements.

1.4 SYSTEM DESCRIPTION

A. Sound-Rated Windows: Pre-engineered window and frame assemblies that are provided with laboratory-tested Sound Transmission Class (STC) ratings by the window manufacturer.

B. Sound-Control Windows: Window and frame systems built up by the General Contractor and his Subcontractors out of specified components. These window assemblies are assigned a Noise Isolation Class (NIC) rating by the project Acoustics Consultant which may be verified after window installation.

1.5 SUBMITTALS

A. Submit shop drawings, manufacturer's data, and product performance certification in accordance with General Conditions.

B. Shop drawings:

1. Provide full size details of frames, glazing, and sound gasket components.

2. Provide installation details applicable to the construction in which the Sound Control Windows and frames will be installed.

3. Indicate construction, sizes, thicknesses, reinforcing, anchoring, and finishes of all materials.

C. Manufacturer's data:

1. Provide illustrations and descriptions of all seals and hardware items which will be exposed on windows and frames for design review by Architect and project Acoustics Consultant.

2. Provide complete installation and adjustment information.

D. Notification of work completion:

1. After installation and prior to acceptance testing, provide a letter to the Architect and the project Acoustics Consultant, co-signed by the General Contractor's project representative, indicating that all Sound-Control Window assemblies have been installed and gaskets have been adjusted to form an airtight seal around the full perimeter of each window panel.

1.6 SEQUENCING AND DELIVERY

A. Upon award of contract and before commencement of building construction, submit to the

Architect any special requirements (scheduling, flatness of floor, etc.) which are necessary to ensure successful installation.

B. Protect window systems during transit, handling and storage to prevent damage, soiling, and deterioration.

C. Deliver frames to General Contractor with complete installation drawings and instructions for installation by the General Contractor and/or his Subcontractor.

D. Protect window assemblies, especially sound gaskets, from damage before, during, and after their installation.

1.7 WARRANTY

A. Window assemblies shall be warranted against defective workmanship, operation and materials for a period of two years from time of final acceptance.

1.8 COORDINATION

A. Sound-Control Windows require coordination with the work of other disciplines not described in this Specification. Coordination is especially required with fire ratings.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The window assemblies shall be configured as indicated on the Contract Drawings.

B. The window hardware shall be sized to support the weight of the window and provide easy movement by one person where windows are operable.

C. The gasketing system shall provide an airtight seal around the entire perimeter of the window when closed.

2.2 SOUND-CONTROL WINDOW TYPES

A. SCW-1: OINIC 55. Fixed window assembly consisting of dual panes separated by an airspace as detailed, with removable sash on interior side. Glazing shall be 3/4-inch laminated glass on interior side and 1-inch insulating glass on exterior side. Insulating glass shall consist of 1/4-inch laminated glass and 1/4-inch Low-E glass separated by 1/2-inch minimum airspace. Frames filled with mineral wool. Neoprene/silicone gasketing. Sound-absorbing materials along perimeter of cavity between glazing.

B. SCW-2: NIC 34. Fixed window assembly consisting of single pane of 1/2-inch laminated glass. Frame filled with mineral wool. Neoprene/silicone gasketing.

2.3 SOUND-CONTROL WINDOW COMPONENTS

A. Neoprene/silicone gasketing: Continuous neoprene setting blocks and/or silicone sealant to form U-shaped gasketing for an airtight seal. Durometer 50-80 Shore A.

B. Sound-absorbing materials at cavity perimeter: One-inch thick, 6-7pcf fiberglass panel covered with acoustically transparent fabric or perforated metal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before commencing installation, examine the substrate and surrounding conditions to verify that there is nothing to prevent proper and timely execution of the installation. Start of work shall indicate acceptance of the substrate and surrounding conditions.

3.2 INSTALLATION

A. Install items plumb (or as indicated on the Contract Documents), straight, square, level, and in their proper elevation, plane and location.

B. At Sound-Control Window Assemblies, windows shall fit accurately within frames to properly engage all seals to form an airtight seal around the entire perimeter of the windows.

C. All hollow metal frames at Sound-Control Windows shall be filled with mineral wool.

D. All work shall be complete in every detail and the finished work shall be clean for the Architect prior to final acceptance.

3.3 ACCEPTANCE TESTING

A. Before acceptance of the installed Sound-Control Window assemblies, and at any time within the project guaranteed period, the Owner, Architect, or project Acoustics Consultant may request that acoustical performance testing of the installations be performed. Expenses for the project Acoustics Consultant to perform this testing shall be paid by the Installing Contractor.

B. Sound-Control Window installations shall be deemed acceptable if the assemblies meet or exceed a Noise Isolation Class (NIC) or Outdoor-Indoor Noise Isolation Class (OINIC) which is equal to the specified NIC or OINIC rating as applicable. Measurements are to be conducted in accordance with procedures set forth in ASTM E336-05 or ASTM E996-04, as applicable, with the following exceptions and additions:

1. This test is intended to measure the performance of a Sound-Control Window assembly and it is, therefore, important that microphone positions be selected to obtain data for sound transmission through that assembly. For this test, microphone positions may be as little as 0.5 m (approx. 1'-8") apart.

2. Exterior windows shall be tested in accordance with procedures set forth in ASTM E966-

04 with the Outdoor-Indoor Level Reduction (OILR) values used to calculate a single number rating defined in this Specification as Outdoor-Indoor Noise Isolation Class (OINIC), using the same procedures as those used to determine NIC from NR (Noise Reduction) values per ASTM E413-04.

C. Failure to meet or exceed the required field test may require the following procedures to be followed:

1. Gaskets shall be scanned while a broad-band noise source (as described in ASTM E336-05 or ASTM E996-04, as applicable) is operating on the opposite side. If necessary, the gaskets shall be Contractor-adjusted so that A-scale values at 6 inches from the gaskets are not more than 4 dB(A) greater than A-scale values measured 6 inches away from the center of the window.

2. If all the perimeter gaskets pass or are adjusted to pass the above scanning test and the specified NIC value is still not achieved, the project Acoustics Consultant, Architect or the Owner may request that flanking checks be made. The check may involve taping of all gasketed joints using a special adhered tape designated by the project Acoustics Consultant.

3. If the taped assembly achieves the specified NIC value, the Installing Contractor shall be responsible for the cost of taping and whatever additional adjustments, modifications and tests are necessary to meet the specified NIC value for the fully operating assembly.

4. If the taped assembly does not yield the specified NIC value, then flanking, panel deficiency, or both may be responsible. If, by the judgment of the project Acoustics Consultant, there is no unequivocal indication whether flanking or panel deficiency is the probable cause, then checks for flanking transmission using a supplemental panel barrier (as described in Annex A1 of ASTM E336-05 or ASTM E996-04, as applicable) will be conducted.

5. If flanking transmission is revealed by these checks, then the Architect, Owner, project Acoustics Consultant, and General Contractor shall determine appropriate corrective measures to eliminate the flanking paths and responsibilities for both corrections and costs of testing and retesting. The surrounding construction shall be deemed satisfactory when the specified NIC value has been met with the supplemental panel barrier in place.

6. If the specified NIC value is no longer met after removing the supplemental panel barrier, then window panel deficiencies and/or some other fault directly associated with the window assembly are indicated as the cause of unsatisfactory performance. The Installing Contractor shall be responsible for accomplishing modifications and subsequent retesting until the operating assemblies perform as specified.

7. If the window assembly in question is so large that these procedures are unreasonably difficult or extraordinarily costly, then the Architect, Owner, project Acoustics Consultant, and General Contractor shall determine appropriate alternative procedures.

END OF SECTION

METAL FRAMED SKYLIGHTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum skylight framing system.

B. Fasteners, anchors, reinforcement, and flashings.

1.2 RELATED REQUIREMENTS

A. Division 1 Section “Design Build Requirements.”

B. Division 7 Section “TPO Single Ply Membrane Roofing” roofing system and base flashing at skylight curb.

C. Division 7 Section “Sheet Metal Flashing and Trim.”

D. Division 7 Section “Joint Sealants.”

E. Division 8 Section “Glazing.”

F. Division 8 Section “Sound-Control Windows.”

1.3 REFERENCE STANDARDS

A. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; American Architectural Manufacturers Association; 2009.

B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2011.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2008.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.

E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.

F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.

G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2012.

H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2012.

I. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2011.

J. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a.

K. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2005 (Reapproved 2010).

L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.4 PERFORMANCE REQUIREMENTS

A. Delegated-Design: Design metal-framed skylights, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Delegated-Design Requirements: Contractor is responsible for the design and installation of metal-framed skylights that comply with all Codes in effect at project location. Contractor is responsible for obtaining special permits as required by the Building Official having jurisdiction over construction at project site. Provide calculations, layouts and other information required for permitting. Coordinate required inspections and attain all required approvals

B. Design and size components to withstand the following load requirements without damage or permanent set:

1. Roof Snow Load: As indicated by structural design data on drawings.

2. Wind Load: As indicated by structural design data on drawings.

3. Seismic Load: As indicated by structural design data on drawings.

4. Roof snow load: 27 lbf/sq ft plus snow drifting depending on location of skylight.

5. Concentrated load at any location on framing: 250 lb.

6. Measure performance by testing in accordance with ASTM E 330, using test pressure equal to 1.5 times the design wind load and 10 second duration of maximum load.

C. Maximum allowable deflection of any glazing support member: 1/240 of span.

D. Design system to limit stress on structural glazing adhesive to 20 percent of tested tensile adhesion and maximum compression or elongation to 25 percent of neutral dimension.

E. Design system to accommodate thermal expansion and contraction over ambient temperature range of 100 degrees F, dynamic loading and release of loads, creep of concrete structural members, and deflection of structural support framing without damage to skylight system components or loss of weathertightness.

F. Thermal Resistance of Skylight Assembly: NFRC Certified System U of 0.50 maximum, submit NFRC CPD number.

G. Thermal Resistance of Light Transmitting Areas: U of 0.28.

H. Limit air infiltration through assembly to 0.06 cu ft/min/sq ft for glazed area, measured at a reference differential pressure across assembly of 6.24 psf in accordance with ASTM E 283.

I. Water Leakage: None, when measured in accordance with ASTM E 331 at a test pressure difference of 8.00 lbf/sq ft.

J. Design and fabricate skylight system to prevent harmonic vibration, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

K. Provide all skylights that meet OSHA/OR-OSHA fall restraint requirements, without the use of exterior railings.

1.5 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product Data: Provide manufacturer's specifications, standard details, and installation requirements.

C. Shop Drawings: Indicate framed opening requirements and tolerances, spacing of all members, anticipated deflection under load, affected related work, expansion and contraction joint locations and details, and sizes and locations for field welding.

D. Selection Samples: Submit full range of aluminum finish samples for Architect's color selection.

E. Test Reports: Submit results of full-size mock-up testing certified by an independent test laboratory. Reports of tests previously performed on the same design are acceptable.

F. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations by a professional Engineer licensed in the State of Oregon.

G. Structural Glazing Adhesive: Submit product data and calculations showing compliance with performance requirements. Submit QC procedure for application, testing and inspection of structural sealants where required at horizontal joints.

H. Manufacturer and Installer Qualifications as described under Paragraph"Quality Assurance."

I. Report of field testing for water leakage.

J. Delegated-Design Submittal: For metal-framed skylights indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

K. Fall Restraint Skylights: Provide engineering and test data as required to confirm compliance with OSHA Fall Restraint at all skylights.

L. NFRC Certified Product Directory Number specific to this project system make up.

1.6 QUALITY ASSURANCE

A. Design skylight system under direct supervision of a professional structural engineer experienced in design of work of the type specified in this section and licensed in the State in which the Project is located.

B. Manufacturer and Installer Qualifications: Provide a list of projects that have not had glazing replaced over 10 years.

C. Manufacturer Qualifications: 20 years of documented experience with the system for this project used successfully on projects of similar size and scope. Provide list of a minimum of ten (10) projects in place 20 years or longer with contact references.

D. Installer Qualifications: Company specializing in performing the work of this section with no fewer than 10 years of experience. Provide documentation of minimum of 10 projects of similar size and scope.

1. Provide documentation of a minimum 10 projects using the system for this project that have been in place for 20 years that have not had an insulated glass failure. Include contact information for the project Architect and Owner.

E. Field Measurements: Before beginning skylight fabrication, measure field conditions to assure proper fit of finished assembly.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Provide wrapping to protect prefinished aluminum surfaces. Do not use adhesive papers or spray coatings that bond when exposed to sunlight or weather.

1.8 WARRANTY

A. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal wall panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

1. Finish Warranty Period: 5 years from date of Substantial Completion.

B. Correct defective work, including leaks, discoloration, and excessive thermal or structural movement, within a ten year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Framed Skylights: Provide products manufactured and installed by one of the following:

1. Manufacturer/Installer: DeaMor; www.deamor.com (Basis of Design) Contact: 1-888-284-6799.

2. Manufacturer/Installer: Supersky; www.supersky.com.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 METAL-FRAMED SKYLIGHTS

A. Metal Framed Skylights: Factory-fabricated, dry glazed with all horizontal joints flush glazed to allow water to flow freely off the skylights

1. Frame: Extruded aluminum structural members with integral cascading condensation collection and guttering system thermally separated from exterior pressure bar.

2. Weep System: Baffled weep holes to allow moisture to drain from the system and prevent blow back of water from the system.

3. Glazing System: Pressure glazing bar system for sloped joints and structural adhesive flush glazing for all horizontal joints including the eave at the bottom of the slope.

2.3 SKYLIGHT COMPONENTS

A. Frame: Extruded aluminum structural members with mechanically connected structural horizontal cross members to provide continuous support at the glass edge and lateral bracing of the frame as required. Thermally disconnected from exterior pressure bar.

1. **Components (as noted but not limited to):**

a. **EAVE ANGLE ASSEMBLY**

b. **DOUBLE PITCH CROSSBAR ASSEMBLY**

c. **RAKE ASSEMBLY**

d. **SHT MTL APRON FLASH**

e. **SHT MTL RIDGE FLASH**

f. **PARAPET CAP**

B. Glazing System: Glazing Gaskets: Extruded silicone gaskets mechanically interlocked into all framing and cap members that come in contact with the glass.

2.4 MATERIALS

A. Aluminum Extrusions: 6063-T5, 6063-T6, or 6061-T6 members complying with ASTM B221 (ASTM B221M). Minimum thickness 0.125 inch for structural members and 0.062 inch for non-structural members.

B. Formed Aluminum: Sheet material of alloy 5052, 5005, or 6061-T651 complying with ASTM B209 (ASTM B209M). Minimum thickness: 0.125 inch (3 mm) for structural members and 0.062 inches for non-structural members.

C. Internal Reinforcement: ASTM A36/A36M; Steel shapes as required for strength and mullion size limitations, hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

D. Glass: Type GLASS TYPE 4 specified in Division 8 Section “Glazing.”

E. Glazing Accessories: As recommended by manufacturer of skylight system.

F. Structural Glazing Adhesive: Silicone, ASTM C920, Class 25, Grade NS, neutral cure; maximum hardness of 40, when tested in accordance with ASTM D2240 using Type A durometer; minimum tensile strength of 250 psi, when tested in accordance with ASTM D412.

1. Manufacturer: Dow Corning 995 or equal.

2. Color: Black.

G. Weatherseal Sealant: Silicone, same type as glazing adhesive.

H. Touch-Up Primer for Galvanized Steel Surfaces: Zinc rich type.

I. Flashings: Provided by manufacturer of skylight system. Minimum .040 inches thick or as required to for flat profile in the size and shape shown and provide watertight enclosure.

1. Provide welded flashing transitions where shown.

2. Color of flashing to match color of skylight unless otherwise noted.

2.5 FABRICATION

A. Rigidly fit and secure joints and corners with screw and spline. Make joints rigid, with connections that are flush, hairline, and weatherproof.

B. Fabricate components to allow for expansion and contraction with minimum clearance and shim spacing around perimeter of assembly.

C. Fabricate framing members to drain to exterior any water entering exterior joints, condensation occurring in glazing channels, or migrating moisture occurring within system.

D. Prepare components to receive concealed anchorage devices. Ensure that fasteners and anchorage devices will be concealed upon completion of installation.

E. Prepare continuous glazing support mechanically fastened to the horizontal members to receive field structural glazing as required.

2.6 FINISHES

A. After fabrication, prepare the metal surfaces for finishing in accordance with the finisher's recommendations.

B. Finish: All exposed aluminum surfaces free of scratches and surface blemishes and given an AAMA 611 Architectural Class I clear anodized coating conforming to AA-M12C22A41.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that structural curb is ready to receive skylight system. Coordinate installation of roofing and other adjacent work to ensure weathertight construction.

3.2 PREPARATION

A. Apply 10-mil vinyl Scothrap tape or other suitable separator to dry surfaces to concealed aluminum and steel surfaces in contact with dissimilar materials.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Set skylight structure plumb, level, and true to line, without warp or rack of frames or glazing panels. Anchor securely in place in accordance with approved shop drawings.

C. Maintain assembly dimensional tolerances, aligning with adjacent work.

D. Install all system flashings with approved membranes, overlaps, supports and sealant joints as required.

E. Touch up damaged finishes so repair is imperceptible from 6 feet. Remove and replace components that cannot be satisfactorily touched up.

3.4 TOLERANCES

A. Maximum Variation from Plumb, Level, or Line: 1/8 inch per 10 feet, or 3/8 inch total in overall dimension.

B. Alignment of Two Adjoining Members Abutting in Plane: Within 1/16 inch.

3.5 FIELD QUALITY CONTROL

A. See Division 1 Section “Quality Control,” for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.

B. Test installed skylight for water leakage in accordance with AAMA 501.2.

3.6 CLEANING

A. Remove protective material from prefinished aluminum surfaces.

B. Wash down exposed surfaces; wipe surfaces clean.

C. Remove excess sealant by methods recommended by skylight manufacturer.

END OF SECTION

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Install Owner-furnished door hardware as specified within this Section, except as noted. Lock cylinders installed by Owner.

1.2 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

A. Templates: Furnish templates to metal door and frame suppliers one week from receipt of approved hardware schedule from Owner.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Contractor: Employ an experienced worker to receive, supervise, and distribute hardware at the building site, and provide a locked room with temporary shelving for hardware.

2. Door Closer Manufacturer: Make final adjustments to all door closers.

B. Regulatory Requirements: All hardware shall comply with applicable local and state fire and current building codes. Hardware applied to doors with UL fire rating label shall comply with that rating. Doors installed for smoke protection shall receive hardware as recommended by the NFPA.

C. Pre-Construction Meeting: After receipt of the Owner-provided hardware schedule, conduct a final "hardware function" coordination meeting with the Owner and Architect. Do not release hardware templates to door fabricators until final resolution of the hardware coordination meeting.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Division 1 Section "Summary," Paragraph 1.7, Owner-Furnished products.

1.5 WARRANTY

A. All hardware shall carry a factory warranty for a minimum of one year after Substantial Completion that hardware is free from defects in workmanship and material. Hardware must be installed exactly to the manufacturer’s printed instructions to prevent voiding the warranty. Provide a 3 year material and labor warranty for exit devices and 10 year material and labor warranty for closers.

B. All hardware shall carry an installer's warranty for a minimum of one year after Substantial Completion that hardware is free from defects in installation workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product Manufacturers:

1. ACC: Accurate Lock Company.
2. CRR: Curran Engineering Company.
3. GLY: Glynn Johnson.
4. IVE: Ives.
5. KNC: K.N. Crowder.
6. LCN: LCN.
7. NGP: National Guard Products.
8. SCE: Schlage Electronics.
9. SCH: Schlage.
10. VON: Von Duprin.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Butt Hinges: 1-1/2 pair minimum per door unless scheduled otherwise.

B. Locks and Latches: Verify operation, hand of doors, and function for each opening as scheduled.

C. Keying:

1. It shall be mandatory that keying be done by the lock manufacturer for security, Owner's convenience, and permanent keying records. In the event any keying security procedure is violated, replace all locks, cylinder units, padlocks, cylinders, etc., at no additional expense to the Owner.
2. Provide manufacturer's standard keyway with standard cylinders except where interchangeable core cylinders are specified. Interchangeable core cylinders to have temporary construction cores.

3. Furnish two keys with each lock, and five master keys. Keying and master keying schedule as established by the Owner.

4. All master keys and keying transcript to be sent by registered mail from the factory to the Owner. This procedure is mandatory.

D. Closers: Verify hand of door, degree of opening, frequency of use, and head condition. Furnish cast iron body type only.

E. Silencers: Furnish in number and type to protect finishes wherever doors or hardware thereon will strike adjacent surfaces and materials. Furnish 3 rubber silencers for metal door frames that are not equipped with gaskets.

F. Hardware Finishes: As specified below in the Schedule. Verify all finishes on the Schedule and at the Site.

PART 3 EXECUTION

3.1 INSTALLATION

A. Locate and place hardware on work accurately using templates when required. Install permanently using proper nails, screws or bolts, matching finish of hardware. Remove and place in original packages all hardware after setting to permit application of finishes and reinstall when finish application is complete. Deliver any adjusting tools to Owner properly tagged and identified.

B. Properly wrap all hardware subjected to hand usage during construction for protection. Replace hardware that has damaged finish.

C. Butt Hinges: Install top hinges 5-inches from head of frame or door top to top of hinge. Bottom hinge 10-inches from finished floor to bottom of hinge. Center intermediate hinges between top and bottom hinges.

D. Locks and Latches: Install 38-inches to center line of knob locks and latches.

E. Exit Devices: Mount according to manufacturer’s instructions at 38-inches.

F. Deadlock: Install 48-inches to center line of deadlock. Vary as necessary to avoid conflict with door pulls, etc.

G. Door Pulls and Push Plates: Install 42-inches to center of grip for door pulls and push/pull bars. 48-inches to center line of push plates.

H. Thresholds: Set in bed of silicone sealant. Thresholds requiring additional support, set in bed of non-shrink grout.

DOOR HARDWARE

I. Door Closers: The maximum force to open doors shall not exceed 8-1/2 lbs. for exterior hinged doors and 5 lbs. for interior hinged doors.

3.2 SCHEDULE

Quantity	Item	Item Number	Finish

Group 1:

END OF SECTION

GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services necessary for installation of glass in doors, storefront, skylights, and relites, including all glazing hardware.

B. Examine glass requirements of this project and furnish and install all glass in accordance with the requirements of the Building Code and the US Consumer Product Safety Commission.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA) TIR-A7, Sloped Glazing Guidelines, and Glass Design for Sloped Glazing.

B. American National Standards Institute (ANSI).

C. American Society for Testing and Materials (ASTM):

1. ASTM C1036, Flat Glass.

2. ASTM C1376, Sputter Coated Glass.

3. ASTM C1048, Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.

4. ASTM C1172, Laminated Glass.

5. ASTM E2190, Sealed Insulating Glass Units.

D. Glass Association of North America (GANA), (formerly FGMA) Glazing Manual, Installation Recommendations.

E. Insulated Glazing Certification Council (IGCC), or Insulating Glass Manufacturers Alliance (IGMA), compliant with ASTM E2190.

F. Insulating Glass Manufacturers Alliance (IGMA) (formerly SIGMA) Publications:

1. IGMA TM-3000, Vertical Glazing Guidelines.

2. IGMA TB-3001, Sloped Glazing Guidelines.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by traditional thickness designations according to ASTM C1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass (ASTM C1376): Defects developed from normal use that are attributed to the manufacturing process. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass (ASTM E2190): Failure of hermetic seal under normal use that is attributed to the manufacturing process. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

F. Deterioration of Laminated Glass (ASTM C1172): Defects developed from normal use that are attributed to the manufacturing process. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Thickness in Drawings or Specifications are nominal. Select minimum glass thicknesses to comply with ASTM E1300, according to the following requirements:

a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at height above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.

b. Specified Design Snow Loads: As indicated, but not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0, "Snow Loads."

c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/90 times the short side length or 3/4-inch, whichever is less.

(1) For monolithic-glass lites heat treated to resist wind loads.

(2) For insulating glass.

(3) For laminated-glass lites.

d. Minimum Glass Thickness for Exterior Lites: Not less than 1/4-inch (6 mm).

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings indicating tempered decorative glass pattern.

C. Product Data: For each glass product and glazing material indicated.

D. Samples: For the following products, in the form of 12-inch square samples for glass and of 12-inch long samples for sealants. Install sealant samples between two strips of material representative in color of the adjoining framing system.

1. Insulating glass for each designation indicated.

2. For each color (except black) of exposed glazing sealant indicated.

E. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

F. Product Certificates:

1. Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

2. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

G. Qualification Data: For installers.

H. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

1. Product Test Reports: For each of the following types of glazing products:

a. Insulating glass.

b. Glazing sealants.

c. Glazing gaskets.

I. Structural calculations by a structural engineer registered in the State of Oregon showing that glazing complies with the Building Code and performance requirements.

J. Glass warranties and guarantees.

1.6 QUALITY ASSURANCE

A. The high performance low-e coated thermal insulating glazing units in this specification have been selected as part of the overall building daylighting and thermal performance requirements and absolutely shall not be substituted under any circumstances with other glazing units of lesser performance criteria.

B. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, coated float glass, laminated glass, and insulating glass.

D. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

E. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

F. Glass Product Testing:

1. Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.

2. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated.

G. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.

H. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:

1. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, 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. Submit not fewer than four pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

5. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.

I. Safety Glazing Products: Comply with certification requirements in Consumer Product Safety Commission 16 CFR 1201.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

2. Where glazing units, including ASTM C1038 Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

J. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."

2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."

3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."

4. IGMA Publication for Insulating Glass: IGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

K. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.

2. Associated Laboratories, Inc.

L. **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 mockups in the location and of the size indicated or, if not indicated, as directed by Architect.**

2. **Build glass mockups by installing the following kinds of glass in mockups specified in Division 8 Section "Aluminum-Framed Entrances and Storefronts" to match glazing systems required for Project, including glazing methods:**

a. **Fully tempered glass.**

b. **Coated insulating glass.**

3. **Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.**

M. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. 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.

2. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

D. In addition to the glass manufacturer’s warranty, include a guarantee for replacement and reglazing of units that become defective during a two year warranty period, at no cost to the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for each glazing product is based on the product named. Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.

1. Viracon, Inc.

2. PPG Industries.

3. Guardian Glass.

4. OldCastle BuildingEnvelope.

5. Cardinal Glass.

B. Other Products: Manufacturers are listed in Paragraph 2.2.

C. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

GLAZING

A. General: Glass thicknesses specified are minimum required. Structural calculations required by this Section may require greater thicknesses to comply with local codes. Also, greater thicknesses required where noted on the Drawings.

B. Glass Standards:

1. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

2. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

C. Accessories: Furnish all clips, blocks, felt, and other items required to set all glass throughout the building.

D. Glazing Tape and Sealants:

1. Glazing Tape:

a. Color: Black.

b. Manufacturers: Norton “Norseal V980.”

E. Elastic Glazing Compound:

1. Sealant, metal sash types.

2. Manufacturers: Dow “InstantGlaze.”

F. Insulated Unit Edge Spacers: PPG Intercept Ultra Warm-Edge Spacers with stainless steel U-channel design, color black.

G. GLASS TYPE 2, Clear Insulating Float Glass: 1-inch thick clear, thermal insulating glass. 1/4-inch thick float glass both panes, 1/2-inch air space hermetically sealed. Low-e coating on No. 2 surface. ASTM C1048 Kind FT (fully tempered) where required.

H. GLASS TYPE 4, Clear Laminated Insulating Glass: 1-inch thick thermal insulating laminated safety glass. Two layers of 3/16-inch thick ASTM C1048 Kind HS (heat-strengthened) clear float glass laminated with 0.060-inch thick polyvinyl butyral interlayer inside pane and 1/4-inch thick ASTM C1048 Kind HS (heat-strengthened) clear float glass outside pane. 5/16-inch air space hermetically sealed. Low-e coating on No. 2 surface.

I. GLASS TYPE 9, Clear Tempered Glass: 1/4-inch minimum thickness, ASTM C1048 Kind FT (fully tempered) clear float glass, tempered after cutting.

J. Minimum Performance Requirements for Insulating Glass: PPG Solarban 60 Clear.

1. Transmittance Visible 70 %

2. Transmittance Solar 34%

3. Transmittance UV 18%

4. Reflectance – Visible Light 11%

5. Light to Solar Gain (LSG) 1.79

6. Reflectance - Solar 28%

7. Winter U 0.29

8. Summer U 0.27

9. Shading Coefficient 0.45

10. SHGC 0.39

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops for compliance with the following:

1. Manufacturing and installation tolerances, including those for 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 only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Maintain original labels on each piece of glass, naming manufacturer, quantity and thickness. Deliver other glazing material in original containers with original manufacturer's labels attached. Remove labels as soon as possible after installation.

C. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

F. 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.

G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

H. 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.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

3.4 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

1. For mitered corners, gaskets shall be cut longer than opening in accordance with manufacturer's requirements to prevent pull-back at corners.

B. 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.

C. 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.

3.5 INTERIOR GLAZING

A. Set glass using elastic glazing compound; apply ample compound in rabbet to bed entire perimeter of glass and place necessary setting blocks; press glass, centered, into rabbet.

B. For lites held in place by stop beads all around, bed beads against glass and bottom of rabbet with compound.

C. Secure bead with countersunk fasteners. Strip surplus compound from both sides of glass at an angle; do not undercut.

3.6 CLEANING

A. Clean and remove all stains and excess glazing compound and sealants from glass, sash, and adjoining surfaces. Washing of glass is specified in Division One.

3.7 PROTECTION

A. Protect all glazing from breakage. Reglaze wherever work or material are defective. Replace all glazing damaged prior to Substantial Completion.

B. Do not apply paint or attach temporary signs or festoons directly to glass faces.

END OF SECTION

UO Oregon Bach Festival / Materials & Finishes

01528A

4/29/2016

ACT1 — 09 51 13

ITEM NAME	Acoustic Ceiling Tile	MANUFACTURER	Armstrong
MODEL NO.		VENDOR	Armstrong - Stephen Yeager T 503.319.6853 E SAYeager@Armstrong.com
STYLE/LINE	Ultima Tegular 15/16"		
COLOR			
FINISH		NOTES	
DIMENSIONS	2' w x 4' h		

ACT2 — 09 51 13

ITEM NAME	Acoustic Ceiling Tile	MANUFACTURER	Armstrong
MODEL NO.		VENDOR	Armstrong - Stephen Yeager T 503.319.6853 E SAYeager@Armstrong.com
STYLE/LINE	Optima Tegular 9/16"		
COLOR			
FINISH		NOTES	
DIMENSIONS	2' w x 8' h		

ACT3 — 09 51 13

ITEM NAME	Acoustic Ceiling Tile	MANUFACTURER	Armstrong
MODEL NO.		VENDOR	Armstrong - Stephen Yeager T 503.319.6853 E SAYeager@Armstrong.com
STYLE/LINE	Optima Tegular 15/16"		
COLOR			
FINISH		NOTES	
DIMENSIONS	2' w x 4' h		

UO Oregon Bach Festival / Materials & Finishes
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COUNTERTOP1 — 12 36 61.19

ITEM NAME	Countertop Material	MANUFACTURER	Basix International
MODEL NO.		VENDOR	Basix International
STYLE/LINE	Basix Quartz Surface		
COLOR	Alpine		
FINISH			
DIMENSIONS		NOTES	Metal: 12 36 16 Solid Surface: 12 36 61.16 Quartz: 12 36 61.19

CPT1 — 09 68 13

ITEM NAME	Carpet	MANUFACTURER	Tandus Centiva
MODEL NO.		VENDOR	Tandus Centiva - Michelle Lancaster E Michelle.Lancaster@tarkett.com
STYLE/LINE	Linewave 04846		
COLOR	Circuitboard 21306		
FINISH			
DIMENSIONS		NOTES	
UNDERLAYMENT			
INSTALLATION	Vertical Ashlar		

CT1 — 09 30 13

ITEM NAME	Wall Tile	MANUFACTURER	Pental
MODEL NO.		VENDOR	Pental - Jen Karam T (503) 445-8603 E jen@pentalonline.com W http://www.pentalonline.com/
STYLE/LINE	More		
COLOR	Perla		
FINISH	Velvet		
DIMENSIONS	12" w x 24" h	NOTES	
GROUT			
GROUT JOINT			
INSTALLATION			

PL1 — 06 41 16

ITEM NAME	P-lam	MANUFACTURER	EB Bradley Co
MODEL NO.		VENDOR	EB Bradley Co - Tiffany Rosales T 5032520801 E trosales@ebbradley.com
STYLE/LINE	Metro		
COLOR	Rialto LM60		
FINISH			
DIMENSIONS		NOTES	P-lam cabinets: 06 41 16 P-lam case goods: 12 51 16.19

PLTR1 — 09 25 00

ITEM NAME	Wall Plaster Finish	MANUFACTURER	Procured by Contractor
MODEL NO.		VENDOR	Procured by Contractor
STYLE/LINE			
COLOR	TBD		
FINISH			
DIMENSIONS		NOTES	3/4" depth variation for majority of wall, 1 1/2" depth variation at corners

PNT1 — 09 91 23

ITEM NAME	Wall Paint	MANUFACTURER	Benjamin Moore
MODEL NO.	2121-70	VENDOR	Dick's Color Center 909 SE Salmon Portland, OR 97214 T 503.236.6919 W http://dickscolor.benmoorepaints.com/sb.cn
STYLE/LINE	Aura Interior Paint		
COLOR	Chantilly Lace		
FINISH	Eggshell (524)		
DIMENSIONS		NOTES	Interior paint: 09 91 23 Exterior paint: 09 91 13

PNT2 — 09 91 23

ITEM NAME	Ceiling Paint	MANUFACTURER	Benjamin Moore
MODEL NO.	2121-70	VENDOR	Dick's Color Center 909 SE Salmon Portland, OR 97214 T 503.236.6919 W http://dickscolor.benmoorepaints.com/sb.cn
STYLE/LINE	Aura Interior Paint		
COLOR	Chantilly Lace		
FINISH	Matte (522)	NOTES	
DIMENSIONS			

PNT3 — 09 91 23

ITEM NAME	Trim Paint	MANUFACTURER	Benjamin Moore
MODEL NO.	2121-70	VENDOR	Dick's Color Center 909 SE Salmon Portland, OR 97214 T 503.236.6919 W http://dickscolor.benmoorepaints.com/sb.cn
STYLE/LINE	Aura Interior Paint		
COLOR	Chantilly Lace		
FINISH	Eggshell (524)	NOTES	
DIMENSIONS			

PNT4 — 09 91 23

ITEM NAME	Bathroom Paint	MANUFACTURER	Benjamin Moore
MODEL NO.	2121-70	VENDOR	Dick's Color Center 909 SE Salmon Portland, OR 97214 T 503.236.6919 W http://dickscolor.benmoorepaints.com/sb.cn
STYLE/LINE	Aura Bath & Spa Waterborne Paint		
COLOR	Chantilly Lace		
FINISH	Matte (532)	NOTES	
DIMENSIONS			

WB1 — 06 46 19

ITEM NAME	Wood base	MANUFACTURER	Procured by Contractor
MODEL NO.		VENDOR	Procured by Contractor
STYLE/LINE			
COLOR			
FINISH	Painted to match walls.	NOTES	Reference 100% CD set.
DIMENSIONS	3/4"d x 4"h		

WD1 — 06 20 23

ITEM NAME	Solid Wood Slats	MANUFACTURER	
MODEL NO.		VENDOR	
STYLE/LINE			
COLOR	White Oak		
FINISH	Clear coat	NOTES	
DIMENSIONS			

WDFLR1 — 09 64 29

ITEM NAME	Wood Flooring	MANUFACTURER	Hakwood
MODEL NO.		VENDOR	Hakwood - Peter Alejandro T (310) 567-3229 E alejandro.p@hakwood.com W www.hakwood.com
STYLE/LINE	Duoplank European Oak		
COLOR	Authentic Collection Original		
FINISH	Premier 1-bis micro bevel	NOTES	
DIMENSIONS	7" w x 3/4" h		
UNDERLAYMENT			
INSTALLATION			

WDPNL1 — 06 42 13

ITEM NAME	Wood Wall Panel	MANUFACTURER	Hakwood
MODEL NO.		VENDOR	Hakwood - Peter Alejandro T (310) 567-3229 E alejandro.p@hakwood.com W www.hakwood.com
STYLE/LINE	Duoplank European Oak		
COLOR	Authentic Collection Original		
FINISH	Premier 1-bis micro bevel	NOTES	
DIMENSIONS	7" w x 3/4" h		

WOM1 — 12 48 13

ITEM NAME	Walk Off Mat	MANUFACTURER	Mats Inc
MODEL NO.		VENDOR	Pacific Mat T 206.409.3870 E norav@pacmat.com W http://www.pacmat.com/
STYLE/LINE			
COLOR			
FINISH		NOTES	Mats: 12 48 13 Grilles: 12 48 16
DIMENSIONS			
UNDERLAYMENT			
INSTALLATION			

PLASTER ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment, and services necessary for the installation and finishing of all lath and plaster on CMU.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. Gypsum Association Fire Resistance Design Manual.

C. Metal Lath Association Specifications for Metal Lathing and Furring.

D. Northwest Wall and Ceiling Bureau.

E. USG Co. Lathing and Plastering Handbook.

F. American Concrete Institute (ACI) 524R Guide to Portland Cement Plastering.

1.3 QUALITY ASSURANCE

A. Field Sample: Using one typical room or representative area of at least 100 s.f. selected with Architect's approval, finish surfaces for review by Architect before completion of work of other areas. After acceptance of completed work in the sample area, use that work as the reference standard to be matched by subsequent completed work. Do not proceed with lathing and plastering until all products and finish samples are approved.

B. Pre-Installation Conference: Prior to starting Work and after application of field sample, arrange a meeting at the Project site with applicator, Architect, and the manufacturer's representative to review scheduling and application procedures.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prevent the inclusion of foreign materials and the damage of materials by water, breakage, or freezing. Deliver and store materials in original packages until ready for use. Remove and dispose of all packages or materials showing evidence of water or other damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers are listed below.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Obtain all components and materials of the lath and plaster system from a single manufacturer, or from producers recommended by the manufacturer, unless otherwise indicated.

B. **Lath:**

1. **Expanded Metal Rib Lath: ASTM C847, 1/8-inch high x 2.75 lbs.**

2. **Stucco Netting: ASTM C1032, 1-1/2-inch x 17 gauge self-furring, hexagonal shaped wire mesh.**

C. Metal Molding:

1. **On Metal lath: Dietrich Metal Framing, "CBZA" 1-A Expanded Flange Corner Bead, zinc; "XXZB" 7/8-inch Type 66 Casing Bead, zinc; "VVZJ" Double-V, 7/8-inch expansion joint, zinc; "FHA7" 7/8-inch foundation weep screed, 26 gauge hot-dip galvanized steel.**

D. Fasteners for Attaching Metal Lath to Substrates: Type required for anchoring into CMU.

E. Gypsum Plaster Aggregate: ASTM C35, natural sand.

F. Lime: ASTM C206, Type S.

G. Reinforcing: 1/2-inch chopped fiberglass strands, Type AR.

H. Gypsum Keene's Cement: ASTM C61.

I. Gypsum Plaster: ASTM C28.

J. Building Paper: Grade D building paper UU-B-790A, 30 minute water resistant.

K. Accessories: USG "Imperial Tape."

2.3 MIXES

A. PLTR 1, Gypsum Plaster:

1. Scratch Coat and Brown Coat: Composed of a minimum of one sack of gypsum plaster to 3-cu.ft. of gypsum plaster aggregate.

2. Smooth Trowel Coat: Composed of 50 lbs. lime putty to 100 lbs. gypsum Keene's cement.

PART 3 EXECUTION

3.1 PREPARATION

A. Broom clean work areas before starting plaster work and ensure the building is closed-in and the area is protected from inclement weather. Provide ample ventilation and heat for proper application and curing or drying conditions for plaster. Verify that framing is true and acceptable for lathing and plastering work.

B. For plaster work of all types, maintain continuous work area temperature of 55°F minimum, and 80°F maximum for period of seven days before, during, and eight days following plaster application; heat and ventilation evenly distributed to all areas; with deflectors used to prevent hot-spots and uneven drying defects.

C. Protect all work of other trades while plastering; mask and cover all adjacent finishes subject to damage from plaster. Do not mix plastering materials within the building. Do not discharge plaster waste and water onto finished exterior premises.

3.2 INSTALLATION OF METAL LATHING

A. Install metal lath with its long dimension horizontal and attach at 6-inches o.c. Wire tie lath at side laps not exceeding 9-inches o.c. All fastenings, laps and installation shall conform to the Metal Lath Association Specifications and the recommendations of the Northwest Wall and Ceiling Bureau.

B. Use expanded flange type corner bead, complete with clips and accessories. Types 50, 75, 100 or double-V control joints as applicable. Types 66 casing beads at perimeters of plaster surfaces, exposed and not concealed by molding or other finish. Install control joints (expansion/contraction) to provide areas of not over 100 s.f. of surface and at both corners of doors. Cut lath at all expansion control joints.

3.3 APPLICATION OF PLASTER

A. Skilled plasterers shall be used throughout the work. All surfaces rodded true to an even plane and free from humps and declivities, presenting a smooth and true surface. Protect all adjoining surfaces by covering with masking tape. Neatness of the plasterer is of paramount importance.

B. Tolerances: Do not deviate more than plus or minus 1/8 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed at any location on surface.

C. Gypsum Plaster:

1. Apply to a minimum 3/8-inch finish thickness with a depth variation of 3/4-inch, and 1-1/2-inch depth variation at corners, consisting of scratch coat, brown coat, with finish coat of gypsum Keene’s cement over metal lath.

2. Apply base coats with sufficient material and pressure to form good bond on lath. Scratch the first coat to rough surface then the brown coat brought out to the ground, rodded to a true surface and left rough to receive the finish coat.

3. When the brown coat has set hard and firm and is partially dry, or a thoroughly dry base coat has been evenly wetted, apply the finish coat, 1/16-inch to 1/8-inch thickness.

Allow the finish coat to draw a few minutes, then trowel or float to a true, even surface free from blemishes.

END OF SECTION

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services necessary for the installation and finishing of all gypsum board partitions and ceilings on wood framing and furring. Include installation of acoustical insulation.

B. Related Sections:

1. Division 1 Section “Design-Build Requirements” for suspended gypsum board ceilings.

2. Division 6 Section “Rough Carpentry” for wood framing.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM C 475/C 475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002.

2. ASTM C 754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2004.

3. ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board; 2005.

4. ASTM C 1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2005.

5. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2004.

B. GA-600 - Fire Resistance Design Manual; Gypsum Association; 2006.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Suspended Ceiling Design Data: Copies of Engineered Design calculations, drawings and documentation prepared by a structural engineer registered in the State of Oregon showing compliance with seismic loading requirements. Include manufacturer’s literature or ICC Reports and identification of connection devices and approved loading capabilities.

1.4 QUALITY ASSURANCE

A. Seismic Requirements: The suspended ceiling system for this building must be engineered for the appropriate forces due to the buildings classification as an Occupancy Category 3 or 4 (OSSC, table 1604.5). Provide structural calculations and details for the vertical and, if

applicable, the lateral forces. Refer to State of Oregon Interpretation No: 2010 OSSC Section 1613.1 which may be found at http://www.cbs.state.or.us/bcd/programs/structural_interps.html.

B. Fire Resistance Ratings:

1. Comply with fire resistance ratings as required and approved by the governing authorities and codes. Provide classification labeled materials, and accessories identical to that of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction for the type of construction scheduled.

2. Reference the Drawings for wall and ceiling types that indicate specific testing lab assembly and material requirements.

C. Provide completed assemblies complying with ASTM C 840.

D. All gypsum board products shall be manufactured in the United States of America.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery with installation to minimize storage periods. Deliver in unopened containers, bundles or packages fully identified with the manufacturer’s name, brand, type and grade. Protect from weather, soiling and damage.

B. Steel framing and related accessories shall be handled in accordance with the A.I.S.I. "Code of Standard Practice."

1.6 PROJECT CONDITIONS

A. Examine the conditions under which the gypsum board is to be installed. Commencement of work establishes acceptance of work conditions.

B. Installation not permitted until a uniform temperature of 55°F to 70°F can be maintained in the building and ventilation provided to eliminate excessive moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed in Paragraph 2.2.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Obtain all components and materials of the gypsum board system from manufacturers recommended and approved by the gypsum board manufacturer, unless otherwise indicated.

B. Gypsum Board:

1. Walls and Ceilings: G-P Gypsum Corporation “ToughRock Fireguard,” or USG “Sheetrock Brand Firecode,” Type X fire retardant type, 5/8-inch thick, tapered edges, 48-inches wide and in lengths as long as practical to minimize number of joints. UL labeled and ICC approved, ASTM C1396.

2. High Moisture Areas: G-P Gypsum Corporation "DensArmor Plus Fireguard," or USG "Sheetrock Brand Mold Tough Ultracode Core," 5/8-inch thick, Type X fire retardant, moisture resistant ASTM C1178, mildew resistant ASTM D3273, UL labeled and ICC approved.

C. Ceramic Tile Backing Board: G-P Gypsum Corporation "Dens-Shield Fireguard Tile Backer," 5/8-inch thick, glass mat facings front and back, ASTM C1178, Type X fire retardant, mildew resistant ASTM D3273, UL labeled and ICC approved.

D. Exterior Gypsum Soffits:

1. Soffit Sheathing: G-P Gypsum Corporation "Dens-Glass Gold Fireguard," Type X fire retardant, silicone-treated water resistant core, glass mats both facings and long edges, 5/8-inch thick, 4-foot x 8-foot, ASTM C1177, mildew resistant ASTM D3273, UL labeled and ICC approved.

2. Joint Tape: Minimum 2-inch wide 10 x 10 woven glass mesh tape.

3. Soffit Finish: G-P Gypsum Corporation "GyProc 90" setting type joint compound.

E. Liner Board: G-P Gypsum Corporation "Dens-Glass Ultra Shaftliner,"1-inch thick, Type X shaft wall liner ASTM C1396, UL labeled and ICC approved, coated glass mat both facings ASTM C1177, mildew resistant ASTM D3273, beveled edge, lengths as required.

F. Shaft Wall Metal Studs:

1. Provide in widths and dimensions as required, fabricated from 33,000 psi, ASTM A653 G40 hot-dip galvanized steel or equivalent corrosion resistant coating, listed by ICC for structural design properties, ASTM A1003.

2. Types J, E and C-H shaft wall studs and tabbed runner in gauges as required for minimum design loading.

3. Manufacturers:

a. ClarkDietrich Building Systems.

b. Steeler.

c. SCAFCO Corporation.

G. Ceiling Metal Furring and Runners:

1. 22 gauge hat shaped channel, ASTM A653 G40 hot-dip galvanized steel or equivalent corrosion resistant coating, 1-3/8-inches wide, 7/8-inch deep with hemmed legs, and Z furring channel, ASTM A1003.

2. 16 gauge cold-rolled steel channel, black paint, 1-1/2-inches deep and 3/4-inch deep, ASTM C645.

H. Tie and Hanger Wire: 8 gauge galvanized wire for hanging channels, 12 gauge galvanized wire for seismic bracing, and 16 gauge soft annealed wire for tying furring channel.

I. Fasteners: Types G and S screws in required lengths and to suit requirement of application to 22 gauge studs, ASTM C1002. Type S-12 screws in required lengths for attachment to heavier gauge metal framing, bugle or pan head as required, ASTM C954. Type W screws or annular ringed nails for wood framing, Type GWB-54, 1-7/8-inch length. Parker or six penny (6d) cooler type nails.

J. Joint Treatment: Provide materials from same manufacturer as gypsum board, ASTM C475/C475M.

1. Joint Tape:

a. Gypsum Board: Paper.

b. Glass-Mat Gypsum Soffit Board: 10-by-10 glass mesh.

c. Tile Backing Panels: As recommended by panel manufacturer.

2. Joint Compound for Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

a. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.

b. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

c. Use setting-type compound for installing paper-faced metal trim accessories.

d. Fill Coat: For second coat, use drying-type, all-purpose compound.

e. Finish Coat: For third coat (final coat of Level 4 finish), use drying-type, all-purpose compound.

f. Skim Coat: For final coat of Level 5 finish on glass mat surfaced boards, use drying-type, all-purpose compound.

3. Joint Compound for Exterior Applications:

a. Glass-Mat Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.

4. Joint Compound for Tile Backing Panels:

   a. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

   b. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

K. Acoustical Insulation:

1. Friction fit, un-faced, formaldehyde-free fiberglass batt insulation containing at least 25% post-consumer or 50% post-industrial recycled glass. Comply with local code, Class I flame-spread rating of 15 to 25 as tested per ASTM E84, and with ASTM C665, Type I, R-11.

L. Caulking: Refer to Division 7 Section “Acoustical Joint Sealants” for sealing joints and penetrations at acoustically significant construction.

M. Electrical Receptacle Box Putty Pads: Refer to Division 7 Section “Acoustical Joint Sealants” for sealing joints and penetrations at acoustically significant construction.

N. Trim Accessories:

1. Hot-dip galvanized steel corner beads, edge trim, and control joints, ASTM C1047.

2. Shapes indicated below by reference to Fig. 1 designations in ASTM C1047:

   a. Corner bead on outside corners, unless otherwise indicated.

   b. LC-bead with both face and back flanges; face flange formed to receive joint compound, provide for edge trim unless otherwise indicated.

   c. L-bead with face flange only; face flange formed to receive joint compound, provide where indicated.

   d. U-bead with face and back flanges; face flange formed to remain without application of joint compound, provide where indicated.

   e. One-piece control joint formed with V-shaped slot, with removable strip covering slot opening.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation Standards:

1. Installation of steel framing members, ASTM C754.

2. Installation of gypsum board assemblies, ASTM C840.

B. Suspended Ceiling Metal Framing System:

1. Secure hanger wires to overhead construction spacing at not over 4-feet o.c. in each direction to support main runners installed with web vertical, at 4-feet o.c. Provide hangers within 6-inches of runner ends and at all interruptions of ceiling or grid. Each hanger to support not over 16 s.f. of ceilings weighing a maximum of 10 lbs./s.f. Install additional hangers to support any additional weight supported by the grid.

2. Saddle-tie the furring channels to main runners with two strands of 16 gauge tie wire. Install additional cross reinforcing at light troffers or any other openings interrupting the installation.

3. Brace main runners and furring channels for seismic loading as required by governing jurisdiction.

4. Fasten hat channels to main runners, spacing as detailed.

C. Gypsum Board:

1. Prior to commencing gypsum board installation, install acoustical insulation where detailed in accordance with insulation manufacturer’s installation instructions.

2. In areas where gypsum board is called for on the walls and ceiling, install the ceiling first then the wall unless detailed otherwise.

3. Sound Rated Partitions: Refer to Division 7 Section “Acoustical Joint Sealants” for sealing joints and penetrations at acoustically significant construction.

   a. Line the inside of equipment recesses with gypsum board to maintain the integrity of sound-rated wall construction.

4. Use gypsum board panels of maximum practical length to minimize end joints. Arrange joints on opposite sides of partition walls to occur on different studs and stagger butt joints on the same surface. Where partitions intersect exterior walls, start installation at exterior end to position butt joints as far away from exterior wall as possible. Board shall be brought into contact but not forced into place with all ends and edges neatly fitted. Use "Floating Interior Angle" application at all ceilings. Bottom edge of gypsum board on walls shall be a minimum of 1/4-inch above floor and a maximum of 1/2-inch above the floor.

5. Attach gypsum board to metal framing with all edges over framing members using screw fasteners spaced at 12-inches o.c. on ceilings and 16-inches o.c. on walls, staggered on abutting edges. Power drive screws at least 1/32-inch deep.

6. Attach gypsum board to wood framing supports, fasten 7-inches o.c. on ceilings and 8-inches o.c. on walls. For double fastening method, apply first fastener12-inches o.c. with second fastener in close proximity (2-inches). Fasteners spaced at not less than 3/8-inch from edge and ends of board.

7. While fasteners are being driven, hold gypsum board in firm contact with underlying supports, fastening from the center of the board toward ends and edges. Drive fasteners tight, with heads slightly below surface, taking care to avoid breaking the paper face.

8. For double layer panel application, install either by screw attachment or adhesive method. Screw-attach the outside layer of boards installed by adhesive method. Apply both layers vertically with joints in face layer offset from joints in base layer.

9. Cut board neatly and fit around pipes, electrical outlets, mechanical work, etc. Remove any loose face paper at cuts and fill holes or openings with quick setting plaster. Where board appears loose from framing, install second fastener within 1-1/2-inches of first.

10. Finish in every location with metal edge and corner bead unless finishing details are given and edge is covered with molding or trim. Install control joints vertically at corners of door frames, and at a maximum of 30-feet apart on unbroken wall surfaces.

11. Use water-resistant type board at wet and high moisture areas. Seal all cut ends and openings with recommended sealant.

D. Sealant Application: Refer to Division 7 Section “Acoustical Joint Sealants” for sealing joints and penetrations at acoustically significant construction.

E. Ceramic Tile Backing Board: Install as a substrate to all ceramic tile on walls. Before starting the installation, verify that all framing supporting ceramic tile is spaced no greater than 16-inches o.c. Install horizontally with end joints over framing members. Secure to framing with screws spaced not more than 8-inches o.c. with 1-inch bugle head Type S High-Low screw.

F. Shaft Wall Erection:

1. Install in accordance with Gypsum Association Fire Resistance Design Manual. Shaft wall 1-hour rated assemblies, designed for a minimum 5 lbs./s.f. loading at stairways and mechanical shafts, and 7.5 lbs./s.f. at elevator shafts, maximum 1/240 deflection.

2. Position steel tabbed runners at floor and ceiling with the short leg toward finish side of wall and securely attach runners to structure with power driven fasteners at ends and at 24-inches o.c. Cap ends of run with shaftwall studs. Attach to steel framing that is to be fireproofed before spraying.

3. Insert coreboard liner panels between floor and ceiling tabbed runners with shaftwall studs between panels.

4. Install full length steel shaftwall studs over shaft wall liner at T-intersections, corners, columns and both sides of closure walls. Suitably frame all openings to maintain structural support for wall.

5. One-Hour Assembly: Apply one layer of 5/8-inch thick Type X gypsum board vertically to the C side of studs with 1-inch Type S gypsum board screws at 12-inches o.c. in studs and runners.

G. Joint Finishing:

1. Level 1, ASTM C840 and GA-214-10: Rough taping permitted only in concealed spaces and service or unfinished areas as scheduled, including gypsum board which will be covered by rigid finish material fully concealing joints and which will not telegraph unevenness.

2. Level 4, ASTM C840 and GA-214-10:

   a. Tape joint compound and finishing compound as recommended by manufacturer of gypsum board.

   b. Using suitable tool or machine, apply a thin uniform layer of joint compound approximately 3-inches wide to the joint to be reinforced.

   c. Center tape over the joint and seat into the compound, leaving sufficient compound under the tape to provide proper bond.

   d. Apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories.

   e. Touch-up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.

   f. Use only water resistant materials with moisture resistant type gypsum board.

   g. Upon completion of finish sanding to a smooth surface, remove all dust from wall surface. Wipe down the entire wall surface with a damp sponge mop.

   h. Apply Level 4 Finish to all exposed paper faced gypsum board, except where Level 1 is allowed.

3. Level 5, ASTM C840 and GA-214-10:

   a. Add to Level 4 finish, one finish coat over entire surface.

   b. Touch-up and sand as needed to produce a surface free of visual defects and ready for decoration.

   c. Upon completion of finish sanding to a smooth surface, remove all dust from wall surface. Wipe down the entire wall surface with a damp sponge mop.

   d. Apply Level 5 Finish to all exposed fiberglass faced gypsum board surfaces.

4. Exterior Gypsum Soffits: Tape joints with fiberglass tape and skim coat entire surface using setting type joint compound. Finish to a level 5 smooth surface ready for painting.

3.2 CLEANING

A. Do not dispose of or leave excess gypsum board materials or debris on the premises. Leave each area broom clean after completing gypsum board work. Clean spots and spills of taping and finishing compounds from all adjacent surfaces and equipment.

END OF SECTION

CERAMIC TILING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the installation of ceramic tile.

B. Related Sections:

1. Division 9 Section "Gypsum Board" for installation of ceramic tile backing board.

2. Division 9 Section "Finish Schedule."

1.2 REFERENCES

A. American National Standards Institute (ANSI), Specifications for the Installation of Ceramic Tile, A108.1,.4,.5,.6,.8,.9,.10; A118.1,.3,.4,.7,.8; A136.1; and A137.1.

B. American Society for Testing and Materials (ASTM) C206, Finishing Hydrated Lime.

C. Tile Council of North America, Inc. (TCNA) Handbook for Ceramic, Glass, and Stone Tile Installation, current edition.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Tile and grout samples for review of color selection.

1.4 QUALITY ASSURANCE

A. All work performed by workers skilled in the installation of ceramic tile in accordance with TCNA recommendations, specifications and tile manufacturer's instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials in manufacturer's unbroken packages and properly store to protect from contamination.

1.6 WARRANTY

A. Provide manufacturer’s standard warranty, one year minimum. This Warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Ceramic Tile: Refer to Division 9 Section “Finish Legend.”

A. Mortar, Grout, and Adhesive:

1. Laticrete International.

2. Mapei Corporation.

3. TEC, Inc.

B. Other Products: Manufacturers are listed below.

C. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 PERFORMANCE

A. Latex Portland Cement Adhesive Mortar: Shall be weather, frost, shock resistant and shall meet the following physical requirements in compliance with ANSI A118.4 test methods:

1. Compressive Strength: Thin bed bonding, grouting mortars, 5000 psi min.

2. Tensile Strength: Thin bed, bonding, grouting mortars, 500 psi min.

3. Bond Strength: Thin bed, bonding, grouting mortars, 500 psi min.

4. Water Absorption: 4% max.

5. Ozone Resistance: 200 hours at 200 ppm, no loss of strength.

6. Smoke and Flame contribution factors: 0.

B. Water-Cleanable Epoxy Grout: Shall be stainproof, chemical resistant 100% solids epoxy with high temperature resistance and shall meet the following minimum physical requirements in compliance with ANSI A118.3 test methods:

1. Compressive Strength: 4500 psi min.

2. Shear Bond Strength: 1000 psi min.

3. Water Absorption: 0.5% max.

4. Service Temperature: Up to 230°F.

5. The finished epoxy grout shall be chemically and stain resistant to ketchup, mustard, tea, coffee, milk, soda, beer, wine, bleach (5% solution), ammonia, juices, vegetable oil, detergent, brine, sugar, cosmetics, and blood. It shall also be chemically resistant to dilute acids and alkalis, gasoline, turpentine, and mineral spirits.

2.3 MATERIALS

A. Ceramic tile shall be Quality Certified by the TCNA, ANSI/TCNA A137.1, and as scheduled.

1. Base: Where wall tile occurs, base is integral with wall tile; at other wall finishes, base is 6-inches high with bullnose top edge. All base shall have a coved bottom edge.

2. Furnish all standard and accessory shapes and sizes as required to complete the work. Do all cutting of units with tile saw.

B. Latex-Portland Cement mortar (Thin-Set): ANSI A118.4, consisting of prepackaged dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive. For wall applications, provide non-sagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

1. Wall Mortar, Thin-Set: Premixed thin-set mortar.

a. Product: Laticrete “254 Platinum” (one-step polymer fortified thin-set mortar).

C. Epoxy Grout:

1. Color: As selected by Architect.

2. Unsanded Products: Laticrete “SpectraLOCK PRO Premium Grout.”

D. Joint Tape: 2-inches wide coated fiberglass tape.

E. Joint Sealant:

1. Mildew resistant silicone sealant. Color as selected.

2. Products:

a. DAP "8640."

b. G.E. "Sanitary 1700."

F. Sealer: As recommended by tile manufacturer.

G. Edge Trim: Schluter Systems "Schluter-SCHIENE-E," stainless steel edge protection, height sized to fit tile.

PART 3 EXECUTION

3.2 EXAMINATION

A. Inspect all surfaces and conditions on which material is to be installed. Notify Architect of any condition that would be detrimental to the proper installation, and verify all environmental requirements.

3.3 INSTALLATION

A. Walls:

1. Walls with Ceramic Tile Backing Board Substrate:

a. Coordinate with Division 9 Section "Gypsum Board" for application of ceramic tile backing board substrate.

b. Check for soundness of framing, adequate fastening, and fit of joints.

c. Cover all horizontal and vertical joints with fiberglass tape embedding in a skin coat of mortar.

d. Use TCNA W245-11 "Coated Glass Mat Water-Resistant Gypsum Backer Board" installation procedure consisting of mortar bond coat on ceramic tile backing board and epoxy grouted ceramic tile. Do not install vapor retarder behind backing board (see installation instructions of ceramic tile backing board manufacturer).

e. Use TCNA W247-11 "Fiber-Reinforced Water-Resistant Gypsum Backer Board" installation procedure consisting of mortar bond coat on ceramic tile backing board and epoxy grouted ceramic tile. Do not install vapor retarder behind backing board (see installation instructions of ceramic tile backing board manufacturer).

B. Sealant: Install in joint between wall base and floor.

C. Sealer: Apply sealer before and after grouting on tiles that the manufacturer recommends sealer application.

3.4 CLEANING

A. Sponge and wash tile diagonally across joints when setting and grouting is complete. Do not use acid or acid cleaner on glazed tile. Acid clean unglazed tile not less than ten days after setting, wet tile before applying acid wash, carefully follow manufacturer's instructions, protect all adjacent surfaces, and thoroughly flush with water when completed. Finally, polish with clean dry cloths.

3.5 SCHEDULE

A. CT 1, Ceramic/Porcelain Tile: Refer to Division 9 Section “Finish Legend.”

END OF SECTION

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment, and services necessary for the installation of acoustical ceilings, complete with suspension systems.

B. Related Section: Division 1 Section “Design-build Requirements” for suspended acoustical ceilings.

1.2 REFERENCES

A. Acoustical and Insulating Materials Association Bulletin.

B. American Society for Testing and Materials (ASTM).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Samples of exposed tee grid and acoustical board for review of color.

C. Shop drawings showing coordination of suspension grid layout with room dimensions and penetrations of ceiling mounted equipment. Include layout of systems utilizing acoustic isolation components.

D. Suspension System Design Data: Copies of Engineered Design calculations, drawings and documentation prepared by a structural engineer registered in the State of Oregon, showing compliance and classification of light, intermediate, or heavy duty system. Include manufacturer’s literature or ICC Reports and identification of connection devices and approved loading capabilities.

E. Manufacturer’s Suspension System Data: When using a standard 24-inch x 24-inch or 24-inch x 48-inch grid system in lieu of an Engineered Design, submit copies of manufacturer’s literature or ICC Report indicating light, intermediate, or heavy duty system. Include fixture schedule and other ceiling supported equipment and their weight, with connection devices and approved loading capabilities.

1.4 QUALITY ASSURANCE

A. Installer’s Qualifications: All work performed by skilled acoustical mechanics in the best and most professional manner. Material installed to provide a proper and symmetrical pattern in each area with joints straight and true and all corners level.

B. Regulatory Agency Requirements: All ratings in conformance with the Acoustical and Insulating Materials Association Bulletin.

C. Seismic Requirements:

1. Suspended acoustical ceiling systems, with or without lighting fixtures, air terminals, or other ceiling mounted items shall comply with the requirements of ASTM C635, ASTM C636, and the building code.

2. Ceiling areas of 144 s.f. or less surrounded by walls which connect directly to the structure above shall be exempt from these standards.

3. Light Duty systems to be used only where no loads other than ceiling acoustical materials weighing not more than 1.5 lbs./s.f. are supported by the suspension system.

4. Intermediate and Heavy Duty classification systems shall be used where suspension system is used to support acoustical material weighing more than 1.5 lbs./s.f., lighting fixtures or other equipment.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Properly store material within the building in such a manner and sufficiently in advance of installation to ensure adjustment to building temperatures and humidities.

1.6 PROJECT CONDITIONS

A. Do not begin installation until residual moisture from concrete, plaster and other wet application material is dissipated, building enclosed with permanent heating/cooling equipment in operation.

1.7 WARRANTY

A. Provide manufacturer’s standard warranty, one year minimum. This Warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

1.8 MAINTENANCE

A. Extra Materials: Furnish to the Owner in factory-sealed containers one full carton of acoustical tile and a 2% overrun of acoustical board from the same production run as that used in this installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acoustical Board: Armstrong, USG, Celotex.

B. Exposed Tee Grid: Armstrong.

C. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. ACT 1Acoustical Board:

1. Mineral fiber, beveled tegular edge, 24-inches x 48-inches x 3/4-inch thick, IBC Class A flame-spread index per ASTM E84, LR 0.90, NRC 0.70, CAC 35 minimum.

2. Product: Armstrong "Ultima Tegular," 1914, color white.

B. ACT 2, Acoustical Board:

1. Fiberglass with DuraBrite acoustically transparent membrane, square tegular edge, 24-inches x 96-inches x 1-inch thick, IBC Class A flame-spread index per ASTM E84, LR 0.90, NRC 0.90.

2. Product: Armstrong "Optima Open Plan Plank Tegular," 3262, color white.

C. ACT 3, Acoustical Board:

1. Fiberglass with DuraBrite acoustically transparent membrane, square tegular edge, 24-inches x 48-inches x 1-inch thick, IBC Class A flame-spread index per ASTM E84, LR 0.90, NRC 0.90.

2. Product: Armstrong "Optima Open Plan Tegular," 3252, color white.

D. Suspension Systems:

1. Exposed Tee for ACT 1 and ACT 3: Main and cross tees, 1-1/2-inches deep, 15/16-inch wide, exposed surfaces finished with flat white baked enamel, color to match acoustical board. Matching wall angles and Armstrong BERC 2 seismic clips.

a. Product: Armstrong “Prelude XL Seismic Rx” at non-fire rated ceilings.

2. Exposed Tee for ACT 2: Main and cross tees, 1-1/2-inches deep, 9/16-inch wide, exposed surfaces finished with flat white baked enamel, color to match acoustical board. Matching wall angles and Armstrong BERC 2 seismic clips.

a. Product: Armstrong “Suprafine XL Seismic Rx.”

E. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

F. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge

PART 3 EXECUTION

3.1 INSTALLATION

A. Suspension Systems:

1. System to be supported on minimum 12 gauge galvanized hanger wire at 4-feet o.c. Suspension wires spaced at greater than 4-feet shall be 10 gauge.

2. Approved type attachment devices capable of supporting five times the ceiling load and not less than 100 lbs. Powder driven devices not permitted. Vertical wires attached with a minimum of three turns and not hang more than 1-in-6 out-of-plumb unless countersloping hangers are provided.

3. Carrying channels and main runners to be level within 1/8-inch in 12-feet with hangers taut. Bending or kinking of hangers not permitted. Deflection limited to 1/360 (1/8-inch) in 4-feet. Fixture loads causing excess deflection shall be independently supported or the grid supplementally supported within 6-inches of each corner, and such loads shall not cause rotation of runners more than 2 degrees from vertical. Provide trapeze type system where obstructions preclude direct attachment. All runners shall be supported within 8-inches of wall or discontinuity.

4. Lateral bracing required in lieu of Engineered Design installed within 4-feet of walls and at 12-feet o.c. in each direction. Install four 12 gauge wires within 2-inches of a main runner intersection with a cross runner and splayed at 90 degrees from each other and at an angle not exceeding 45 degrees of the ceiling plane.

5. Adjacent and parallel to the wall, secure a stabilizer bar to the members perpendicular to the wall to prevent spreading. The wall closure member may be used at two adjacent walls with clearances maintained at the other two walls.

6. Seismic Clips: Install in compliance with ASTM C636, CISCA, and standard industry practices.

7. Light Fixture Support:

    a. Positively attach all lighting fixtures to the suspended ceiling system. The attachment device shall have a capacity of 100% of the lighting fixture weight acting in any direction.

    b. When intermediate systems are used, 12 gauge hangers shall be attached to the grid members within 3-inches of each corner of each fixture. Tandem fixtures may utilize common wires.

    c. Where heavy-duty systems are used, supplemental hangers are not required if a 48-inch modular hanger pattern is followed. When cross runners are used without supplemental hangers to support lighting fixtures, these cross runners must provide the same carrying capacity as the main runner.

    d. Lighting fixtures weighing less than 56 lbs. shall have, in addition to the requirements outlined above, two 12-gauge hangers connected from the fixture housing to the structure above. These wires may be slack. Lighting fixtures weighing 56 lbs. or more shall be supported directly from the structure above by approved hangers.

e. Pendant-hung lighting fixtures shall be supported directly from the structure above using 9 gauge wire or approved alternate support without using the ceiling suspension system for direct support.

8. Air Terminal Support:

a. Ceiling mounted air terminals or services weighing less than 20 lbs. shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.

b. Terminals or services weighing 20 lbs. but not more than 56 lbs., in addition to the above, shall have two 12-gauge hangers connected from the terminal or service to the ceiling system hangers or to the structure above. These wires may be slack.

c. Terminals or services weighing more than 56 lbs. shall be supported directly from the structure above by approved hangers.

B. Exposed Tee Suspension System: Where suspended acoustic tee bar ceilings are called for on the Drawings, the suspension system shall be an exposed T grid. Standard hangers placed 48-inches o.c. in both directions. Exposed metal parts finished with white baked enamel. Suspension system hung in a true plane with a grid pattern of 2-feet x 4-feet unless otherwise noted.

C. Tegular edge boards that are cut to fit less than full size ceiling grid modules shall have a matching tegular edge routed into the cut edge. Paint the routed tegular edge with paint type and color to match the factory finish.

3.2 COMPLETION

A. Adjusting Defective Work: Adjust grid height as required to maintain ceiling system leveled to within 1/8-inch in 12-feet. Remove and replace panels and tiles which are improperly placed, broken, or damaged. Adjust perimeter molding where gaps between molding and vertical surface exceeds 1/8-inch. Adjust suspension system grid to form flush hairline joints.

3.3 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

RESILIENT WOOD FLOORING ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services necessary for the installation and finishing of resilient wood floors including vinyl ventilating base in location indicated on the Drawings.

1.2 REFERENCES

A. APA - The Engineered Wood Association.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Submit 12-inch x 12-inch sample of complete floor systems including pads, plates, sleepers, plywood, flooring, and base.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Materials shall not be delivered, stored, or installed until all masonry, painting, tile work, and other moisture producing work is complete and all overhead mechanical work, lighting, and ceilings are installed. Ideal installation/storage conditions are the same as those which will prevail when building is occupied.

1.5 PROJECT CONDITIONS

A. Do not begin installation until the work of all other trades including painting has been completed and the temperature of the rooms maintained at 70° F at least 48 hours before work proceeds.

B. The Owner will employ the services of an Independent Testing Laboratory (ITL) for testing the moisture content of concrete slabs. Cooperate with the Testing Laboratory by providing the required environmental conditions for moisture testing. Do not proceed with installation until the moisture content does not exceed MFMA required maximum moisture content of 4.5 lbs. per the calcium chloride test ASTM F1869, or provide alternate means of moisture control as approved by the flooring installer at no additional cost to the Owner.

1.6 WARRANTY

A. Warranty: Submit a written warranty executed by manufacturer, installer, and Contractor, agreeing to repair or replace wood flooring that fails in materials or workmanship within the specified warranty period. Failures include, but are not limited to:

1. Buckling, warping, squeaking, and loosening.

2. Excessive open joints or cracks.

3. Deterioration of finishes beyond normal wear.

B. Warranty Period: Three years from date of Substantial Completion.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed in Paragraph 2.2.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Vapor Barrier: 6 mil polyethylene film, ASTM D4397.

B. Resilient Pads:

1. Neoprene pad, 2-inches x 2-inches x 3/4-inch thick.

2. Manufacturers: Mason Industries "Super W," standard 50 durometer.

C. Bearing Plates: 4-inch x 4-inch 16 gauge steel.

D. Sleepers: 2-inch x 4-inch kiln dried fir or pine pressure preservative treated.

E. Plywood:

1. 3/4-inch thick tongue and groove, Group 1, EXT-APA "B-B," with special solid jointed core construction (B-Grade).

2. 4-foot x 8-foot sheets.

F. **RWF-1, Engineered Wood Flooring: _____ .**

G. VRB-1, Vented Rubber Base:

1. ASTM F1861 Type TS, thermoset vulcanized SBR rubber, 4-inches x 3-inches x 4-feet long, vented cove base, molded outside corners.

2. Manufacturers: Johnsonite "Vented Cove."

3. **Color: M-900 Black.**

PART 3 EXECUTION

3.1 INSTALLATION

A. All work performed by experienced workers and installed in full accordance with the manufacturer's instructions. Verify that concrete subfloor is correct to grade and finish.

B. Install dampproof membrane with joints lapped a minimum of 6-inches.

C. Bond bearing plates to top of resilient pads with construction adhesive and fasten to sleepers with one countersunk self-tapping screw, spacing pad assemblies 16-inches o.c.

D. Install sleepers end to end 1/4-inch apart on the ends and spaced 16-inches o.c. with joints offset. Allow 1-inch expansion void at walls and vertical obstructions. Shim as necessary to ensure a flat level floor.

E. Install two layers of plywood over sleepers so that long dimension of the first layer is at right angles to the sleepers and the second layer is parallel to the sleepers, allowing 1/8-inch between sides and ends of plywood sheets. All ends shall bear on sleepers securely and nailed 12-inches o.c. at ends and intermediate bearing with 1-1/2-inch cleat nails. Stagger all joints.

F. Engineered Wood Flooring Installation:

1. Broom clean substrate.

2. Open bundles of flooring material and spread out to allow acclimation for a minimum of 7 days.

3. Lay flooring in direction as indicated on the Drawings. Verify alignment as work progresses.

4. Arrange flooring with end matched grain set flush and tight.

5. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.

6. Install flooring tight to floor access covers.

7. Provide 1/2-inch expansion space at fixed walls and other interruptions.

3.2 PROTECTION OF FINISHED WORK

A. Protect finished Work until Substantial Completion.

END OF SECTION

RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment, and services required to install stair resilient floor covering and base. Prepare floors to receive new material.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Sample of each color and pattern of resilient flooring. Do not start work until samples of material have been approved.

1.4 QUALITY ASSURANCE

A. Conform to resilient flooring manufacturer's installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver finish materials to job site only when satisfactory conditions for storage can be provided. Maintain in manufacturer's unbroken packages with original labels thereon.

1.6 PROJECT CONDITIONS

A. Do not begin installation until the work of all other trades including painting has been completed and the temperature of the rooms maintained at 70°F at least 48 hours before work proceeds.

1.7 WARRANTY

A. Provide manufacturer's standard warranty for each resilient flooring type.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed below.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. RB 1, Rubber Base:

1. ASTM F1861 Type TS, Group 1, thermoset vulcanized SBR rubber, continuous roll, 1/8-inch gauge, 4-inch top-set, coved toe at hard floor finishes, straight base at carpet, 6-inch base at toilet rooms.

2. Manufacturers: Roppe, Flexco, Burke/Mercer, and Nora.

3. Color: TBD.

B. Stair Skirting:

1. ASTM F1861 Type TS, Group 1, thermoset vulcanized SBR rubber, 0.080-inch thick sheet.

2. Color: To match rubber base.

3. Manufacturers: Roppe, Flexco, Burke/Mercer, and Nora.

C. Vinyl Reducing Strip:

1. Size: 1-inch wide; thickness to match floor covering.

2. Manufacturers: Roppe, Flexco, Burke/Mercer, and Nora.

3. Color: As selected by Architect from manufacturer’s full color range.

D. Stair Tread/Riser: Integral Stair Treads-Risers by Johnsonite, Inc.

1. Homogeneous composition of 100% synthetic rubber, additives, and colorants to meet the performance requirements of ASTM F2169 Standard Specification for Resilient Stair Treads, Type TS, Class 1 and 2, Group 1 and 2.

2. 2" wide strip of contrasting color to comply with A.D.A., Visually-Impaired requirements.

3. Tread Pattern and Color: As selected by Architect from manufacturer’s full selection range.

4. Contrasting Strip Texture and Color: As selected by Architect from manufacturer’s full selection range.

5. Other Approved Manufacturer/Product: Nora “Norament Grano Stairtreads.”

E. Adhesives: Refer to product manufacturer's recommendations for appropriate low VOC adhesive. Use only adhesives approved by resilient flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

1. Verify that finishes of substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

3.3 INSTALLATION

A. Vinyl Reducing Strip: Install edge reducing strip at all exposed edges of resilient flooring in doorways or borders of resilient flooring and other floor finish, except not required where carpet binder bar is provided, or at metal thresholds.

B. Base:

1. Install top-set base on floor covering with corners neatly fitted.

2. Install straight base at carpets and coved base at hard floor finishes.

3. Inside corners mitered and outside corners formed from continuous roll extending at least 12-inches beyond corner and installed with contact cement.

4. Install base on cabinets where scheduled.

5. Where wall finish opening at floor is over 1/4-inch, do not install base until gap in substrate has been reduced to 1/4-inch with appropriate filler material.

6. Cut coved toe back at 45 degree angle at door frame terminations.

C. Stair Treads and Risers: Install using manufacturer's written installation system. Applicators shall be experienced in this type of installation.

3.4 CLEANING AND SEALING

A. When stair tread and riser finishes have sufficiently seated themselves to permit cleaning and other trades have completed their work, sweep and damp mop the stairs. Do not wash the stairs for at least 5 days after installation.

END OF SECTION

CARPETING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the installation of carpet.

1.2 REFERENCES

A. American Association for Textile Chemists and Colorists (AATCC).

B. American Society for Testing and Materials (ASTM).

C. Carpet and Rug Institute (CRI).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section “Submittal Procedures.”

B. Shop drawings showing the layout for each area to receive carpet. Show carpet color, trim strips, and any pertinent installation details. Do not install carpet prior to layout approval.

C. Product Data: Data on specified products describing physical and performance characteristics, patterns and colors available, and methods of installation.

D. Written certification from carpet manufacturer to the Owner stating that the register numbered carpet furnished was manufactured in accordance with these Specifications.

B. Samples: Furnish samples of carpet to the job when and as directed by Architect for testing by an independent testing laboratory. Costs for all testing will be paid in accordance with Division 1 Section “Quality Control.”

E. Carpet manufacturer's maintenance and cleaning procedures for maximum life and appearance of carpet. This includes but is not limited to commercial cleaning, spot cleaning and vacuum cleaning for each carpet selected.

F. Warranty, as described below.

G. Certification and description of reclamation and recycling process.

H. Carpet manufacturer certification of compliance with the Carpet and Rug Institute Green label Indoor Air Quality Test Program.

1.4 QUALITY ASSURANCE

A. Indoor Air Quality: Carpet shall meet or exceed the minimum standards contained in the Carpet and Rug Institute (CRI) consumer information label.

1.5 DELIVERY, STORAGE, AND HANDLING

CARPETING

A. Deliver all carpet to the job site in original mill wrappings, each package having register number tags attached or register number marked on packaging. Do not deliver material to job site until notification and arrangements are made to properly handle, store, and protect materials. Store under cover in well ventilated spaces as soon as delivered; protect from damage, dirt, stains, and moisture during transit and storage.

1.6 PROJECT CONDITIONS

A. Do not begin installation until the work of all other trades including painting has been completed and the temperature of the rooms maintained at 70 degrees F at least 48 hours before work proceeds.

B. The Owner will employ the services of an Independent Testing Laboratory (ITL) for testing the moisture content of concrete slabs. Cooperate with the Testing Laboratory by providing the required environmental conditions for moisture testing.

1.7 SEQUENCING AND SCHEDULING

A. Make provisions for and do all necessary work to receive or adjoin other work, install carpet accessories, and provide holes and openings necessary to fit work of other trades.

B. Do not begin carpet installation until after all overhead work is complete and walls are painted.

1.8 WARRANTY

A. Contractor's Warranty: Written one year warranty starting at Substantial Completion and covering all repair or replacement due to defective materials or their installation. Any manufacturer's regular guarantee shall remain in effect for its full duration in addition to Contractor's guarantee.

B. Manufacturer's Warranty:

1. Ten year warranty against 10% loss of face fiber.

2. Ten year warranty against edge ravelling, snags, picks, runs, and delamination.

3. Five year warranty against permanent staining.

4. Five year warranty against fading (at not less than gray scale rating of 4).

5. Carpet warranted not to generate more than 3.5 KV at 70°F and 20% R.H. for life of carpet.

6. Antimicrobial effectiveness warranted for life of carpet.

1.9 MAINTENANCE

A. Extra Materials: Furnish scheduled overrun for future repairs and replacement, wrapped, packaged and labeled at the factory. Same dye lot and run as carpet installed. Save and package usable remnants; label and deliver to Owner.

B. Retain and identify trim pieces of usable size. Package and store same as specified for Overrun, below.

C. Overrun Schedule (each color):

Installed	Overrun
0 - 50 sq.yds.	10%
51 - 250 sq.yds.	5%
251+ sq.yds.	3%

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product manufacturers are listed below.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section “Product Requirements.”

2.2 MATERIALS

A. All materials new and of domestic manufacture. Carpet of first quality and from the same dye lot for each color to be installed. Materials, construction, and appearance are based on the following performance specifications.

B. CPT, Carpet:

1. Manufacturer: Tandus Centiva.
2. Style: Lineweave 04846.
3. Color: Circuitboard 21306.
4. Installation: Glue-down tile, vertical ashlar.
5. Flooring Radiant Panel/Critical Radiant Flux (ASTM E648/NFPA 253): Class I.
6. Smoke Density Test, Flaming Mode (ASTM E662): Less than 450.
7. Methenamine Pill Test (DOC FF-1-70/ASTM D2859): Passes.
8. Electrostatic Propensity Test (AATCC 134): Less than 3 kV

C. WOM 1, Walk-Off Mat: Refer to Division 9 Section “Finish Legend.”

1. Manufacturer: Mats Inc.

2. Style:

3. Color:

4. Installation: Glue-down, recessed.

5. Flooring Radiant Panel/Critical Radiant Flux (ASTM E648/NFPA 253): Class I.

6. Smoke Density Test, Flaming Mode (ASTM E662): Less than 450.

7. Methenamine Pill Test (DOC FF-1-70/ASTM D2859): Passes.

8. Electrostatic Propensity Test (AATCC 134): Less than 3 kV

D. Accessories:

1. Glue-Down: Metal or vinyl edging of standard color to complement carpet color as selected by Architect.

2. Adhesives: Solvent-free adhesives and seam sealants with low VOC emissions as recommended by carpet manufacturer. Zero-VOC if available, maximum VOC level not to exceed 50 g/l. The use of seam sealants containing 1,1,1-trichloroethane or toluene shall not be allowed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of carpet products.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of carpet products.

B. Concrete Substrates: Prepare according to ASTM F710 except for:

1. Moisture testing paid for by Owner;

2. Removal of curing compounds and hardeners used to reduce moisture emission;

3. Repair of concrete floors performed by Division 3 Section “Cast-in-Place Concrete.”

CARPETING

C. Do not install carpet until all other trades have completed their work in the area to be carpeted.

D. Inspect carpet before laying for streaking, shading, spots, soil, tears, pull tufts, or other defects. Remove defective carpet from premises and replace with undamaged carpet.

E. Acclimate carpet a minimum of 24 hours prior to installation.

3.3 INSTALLATION

A. Carpet Tile:

1. Blend carpet tiles from different cartons to ensure minimal variation in color match. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

2. Locate change of color or pattern between rooms under door centerline.

3. Fully adhere carpet tile to substrate.

4. Trim carpet tile neatly at walls and around interruptions.

B. Walk-Off Mat:

1. Blend tiles from different cartons to ensure minimal variation in color match. Lay tile in square pattern, with pile direction parallel to next unit.

2. Fully adhere walk-off mat tile to substrate and tight to edges of floor recess.

3.4 CLEANING

A. Remove debris after installation and clean carpet of all spots with manufacturer approved spot remover. Remove all threads with sharp scissors and thoroughly vacuum clean. Installed carpet shall be free of spots and dirt, and be without tears, fraying, or pulled tufts.

3.5 DEMONSTRATION

A. Instruct Owner in proper care and maintenance of the carpet.

3.6 PROTECTION

A. Protection of carpet after completion of installation is specified as general work and is made a part of the work of all trades doing work in areas after carpet installation.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure carpet is without damage or deterioration at the time of Substantial Completion.

END OF SECTION

FIBERGLASS REINFORCED PLASTIC SHEET WALL COVERINGS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment, and services required and incidental to the installation of fiberglass reinforced sheet wall covering as detailed.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

2. ASTM D5319 – Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.

3. ASTM D5420 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).

4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. Crane Composites: Installation Guide For FRP Panels #6876.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Material samples for review and color selection of each type of panel, trim, and fastener.

C. Manufacturer’s Instructions: Manufacturer’s Installation Guide.

1.4 QUALITY ASSURANCE

A. Applicator shall be experienced in manufacturer’s installation procedures and be approved by the manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver finish materials to job site only when satisfactory conditions for storage can be provided. Maintain materials in manufacturer’s labeled and unbroken packages.

1.6 PROJECT CONDITIONS

A. Ambient Conditions:

1. Do not begin installation until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture work has dissipated.

2. During installation, and within 48 hours prior to installation, maintain ambient temperature and relative humidity within limits required by type of panel adhesive used and recommendation of panel adhesive manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace FRP panels that fail within specified warranty period.

1. Failures shall include, but not be limited to substantial defects in material and workmanship, rotting, rusting, corrosion, development of structural surface cracks, or requiring painting or refinishing.

2. Warranty Period: Ten years from date of Substantial Completion.

B. Special Warranty: Installer's standard form in which installer agrees to repair or replace FRP panels that fail due to poor workmanship or faulty installation within the specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product Manufacturers: Crane Composites, Inc., 800-435-0080.

B. Other Approved Manufacturers: NUDO, 800-826-4132.

C. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. FRP-1, Fiberglass Reinforced Plastic Panels:

1. Fiberglass reinforced plastic sheet, 0.075-inch, smooth.

2. Fire Hazard Classification: As tested per ASTM E84, IBC Class III flame-spread index, smoke-developed 450 or less per ASTM E84.

3. Product:

a. Glasbord-PSIF (PSIF) Class C**.**

4. Color: White.

5. Surface Protection: Crane Composite “Surfaseal,” manufacturer’s proprietary molecularly-bonded surface protection film for fiberglass reinforced plastic (FRP) panels.

B. Adhesive: Low VOC as recommended by plastic sheet manufacturer for laminating over gypsum board substrate.

C. Sealant: As recommended by panel manufacturer.

D. Moldings:

1. Material: PVC in matching color.

2. Manufacturer: Crane Composites.

3. Schedule:

a. Top Edge: CP385.

b. Inside Corner: IA851.

c. Outside Corner: OA851.

d. Panel-to-Panel: DB385.

e. Bottom Edge: CP385.

f. End: CP385.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Verify that all surfaces are smooth, level, clean, and free of irregularities that may be detrimental to proper application.

2. Commencement of installation denotes acceptance of substrate.

3. Do not begin installation until the work of all other trades, including painting, has been completed and the temperature of the rooms has been maintained within humidity and temperature requirements by adhesive manufacturer for at least 48 hours before commencing Work.

3.2 INSTALLATION

A. Apply adhesive in accordance with the recommendations of the adhesive manufacturer.

B. Handle and install wall covering in conformance with manufacturer's installation bulletin.

C. Install wall covering to provide a proper symmetrical pattern in each area, with joints straight and true, and all panel edges concealed with appropriate molding for finished appearance; joints sealed with silicone sealant.

3.3 CLEANING

A. Carefully clean all surfaces after application using recommended methods. Any stains or defects apparent after cleaning will require replacement of material.

END OF SECTION

ACOUSTICAL PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services necessary for the installation of rigid fiberglass acoustical wall and ceiling panels.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. Ceiling and Interior Systems Contractors Association (CISCA) Use and Practice Manual.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings.

C. Manufacturer's data sheets.

D. Fabric samples, 12” x 12,” for color and texture selection.

E. Warranty, as described below.

1.4 QUALITY ASSURANCE

A. Field Samples: Install three panels of each acoustical panel system. Acceptable field samples will be used as a standard of comparison for Work on this Project. Acceptable field samples may be incorporated into the Project.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in manufacturer's original packaging, store off the ground, protect from weather and traffic damage. Properly store material within the building in such a manner and sufficiently in advance of installation to ensure adjustment to building temperatures and humidities.

1.6 SITE CONDITIONS

A. Environmental Requirements, Temperature and Moisture: Maintain areas to receive acoustical panel systems at a minimum of 60 degrees F for 72 hours before, during, and for 72 hours after installation. Maintain areas to receive acoustical panel systems at 25% to 55% relative humidity 24 hours before, during, and 24 hours after installation.

B. Acclimate panels at occupancy environmental conditions for three days prior to installation.

1.7 WARRANTY

A. Provide a one year warranty against defects in material and fabrication.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Panel Fabricators:

1. Conwed.
2. GTS Interior Supply, Inc.
3. Jasco Acoustical Wall and Ceiling Products.
4. Lamvin.
5. Wall Technology.
6. Sabin Sound Products.
7. Decoustics.
8. Kinetics Noise Control.
9. Real Acoustix.
10. Auralex Acoustics, Inc., 800-959-3343.

B. Panel Fabric:

1. Design Tex Fabrics West.
2. Knoll.
3. Architex.
4. Maharam.
5. Guilford Industries.
6. Liz Jordan Hill.

C. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. All materials ASTM E84, Class 1.

B. AP-1, Acoustical Panels: Wall Technology “IR 108,” fabric wrapped, high impact acoustical wall panels.

1. Nominally 1-1/8-inches thick, 7 lbs./c.f. density, 1-inch thick rigid fiberglass board with resin hardened edges, faced with a 1/8-inch thick 16-20 lb./cu. ft. molded glass fiber, and wrapped with 100% woven polyester. NRC 0.85 per ASTM C423.

2. Fabric Manufacturer: Tek Wall, color as selected by Architect from manufacturer’s full range of color.

C. Adhesives for Wall Panel Attachment: Product marketed by adhesive manufacturer as no VOC or low VOC and approved by panel manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

A. All Work shall be performed by skilled installers in the best and most professional manner. Material installed to provide a proper symmetrical pattern in each area with joints straight and true.

B. Do not begin application until residual moisture from concrete, gypsum board, and other wet application material is dissipated, building enclosed with permanent heating/cooling equipment in operation.

C. Examine areas scheduled to receive acoustical materials to ensure protection against weather and other hazards, inspect space allocated for proper depth to receive specified material. Coordinate timing of installation with carpenters, electricians, plumbers, and others whose Work may be affected or which may affect this Work.

3.2 INSTALLATION

A. Plan installation for panel sizes and joints as detailed.

B. Install flat wall panels over the gypsum surfaces as detailed. All installation by factory-authorized personnel and in accordance with the manufacturer's instructions.

END OF SECTION

PAINTING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment, and services necessary for and incidental to painting work **including fire retardant treatment of wood products.** Paint all surfaces in finished room areas as scheduled and those which normally require a paint finish for proper appearance and best serviceability such as wood, gypsum board, metal work, flashing, exposed conduit, pipes and ducts, louvers and grilles, unless excepted.

B. Related Documents:

1. "Door Schedule" for door color and paint system.

2. "Finish Schedule" for room color and paint system.

3. Divisions 21 through 23 for painting of mechanical items such as piping, equipment, ductwork, etc., as required by those Divisions.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. Architectural Woodwork Institute (AWI).

C. Master Painters Institute (MPI).

D. The Society for Protective Coatings (SSPC).

E. Painting and Decorating Contractors of America (PDCA).

1.3 DEFINITIONS

A. Regardless of the specular gloss name paint manufacturers give their products, provide specular gloss as measured on a 60° and 85° geometry Parallel-Beam Glossmeter per ASTM D523 and as defined by Master Painters Institute as follows:

1. Gloss Level 1: Traditional matte finish; flat. Gloss at 60°: Maximum 5 units. Sheen at 85°: Maximum 10 units.

2. Gloss Level 2: High side sheen flat; velvet-like finish. Gloss at 60°: Maximum 10 units. Sheen at 85°: 10 to 35 units.

3. Gloss Level 3: Traditional eggshell-like finish. Gloss at 60°: 10 to 25 units. Sheen at 85°: 10 to 35 units.

4. Gloss Level 4: Satin-like finish. Gloss at 60°: 20 to 35 units. Sheen at 85°: Minimum 35 units.

5. Gloss Level 5: Traditional semi-gloss. Gloss at 60°: 35 to 70 units.

6. Gloss Level 6: Traditional gloss. Gloss at 60°: 70 to 85 units.

7. Gloss Level 7: High gloss. Gloss at 60°: More than 85 units.

1.4 SUBMITTALS

A. Submit in accordance with requirements of Division 1 Section "Submittal Procedures."

B. Samples: Samples of mixed paint, wood clear coating applied to surfaces approximating job conditions with test areas painted on job if required. 12-inch x 12-inch minimum size of samples **including wood products treated with fire retardant.** Obtain preliminary approval of samples before doing any work on job.

C. Complete materials list indicating all materials proposed for use; show manufacturer's name, material type and name, color name and formulation, gloss level, and location where material will be used. Revise list for changes made during construction and resubmit. Where paint provided varies from specified manufacturer's product, submit product data for both the specified basis of design product and proposed paint product. Clearly note any variance between submitted product data and specified product data.

D. **Document certifying that wood products were treated with fire retardant by the fire retardant manufacturer's certified applicator and that each piece of treated product received a fire retardant stamp of certification.**

E. Paint manufacturer certification of compliance with the VOC and chemical component limits of Green Seal requirements.

1. Flat paint: Maximum of 50 grams/liter VOC.

2. Non-flat paints and Primers: Maximum of 150 grams/liter VOC.

F. Painting subcontractor's PDCA membership status for national, state, and local levels.

1.5 QUALITY ASSURANCE

A. **Fire retardant coatings applied by applicator certified by the fire retardant manufacturer.**

B. Paints and coatings shall comply with the VOC and chemical component limits of Green Seal requirements.

C. Painter shall be a PDCA member at national, state, and local levels.

D. Mock-ups:

1. Brush-out areas, 5-feet x 5-feet, as selected by Architect for each color and gloss level for review and prior to final color approval. After acceptance of color brush out, use that work as the reference standard to be matched by subsequent completed work.

2. 10 l.f. of paint color and finish for handrails, trim, and other linear elements of in-place surfaces. Acceptable samples may be incorporated into the Work.

3. One brush-out area of approximately 100 s.f. painted with the predominate wall color in a well-lit area selected by Architect. Paint 100 s.f. of primer, 70 s.f. of first finish coat and 40 s.f. of second finish coat such that the completed mock-up will have three levels of paint, i.e., primer only, primer plus one finish coat, and primer plus two finish coats. Leave approved mock-up in place during painting as a standard of comparison to finished work. At completion of painting, repaint mock-up wall as necessary to conceal all lap marks. Brush-out areas shall be applied to the following substrates:

   a. Gypsum board.

   b. Concrete masonry units.

   c. Plaster.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Designate one location for the storage and mixing of materials. Keep location in a neat and clean condition at all times.

B. Deliver materials only when building is closed in and completed sufficiently to prevent freezing and other damage to paint products.

C. Deliver all materials to the job site in new and unopened containers, with the manufacturer's name, brand name, batch number, color, directions for tinting, mixing and application on a printed label on every container.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Paint Manufacturers:

1. PPG Amercoat.

2. Benjamin Moore.

3. Kelly-Moore.

4. R.J. McGlennon.

5. Miller.

6. PPG Pittsburgh Paints.

7. Rodda.

8. Sherwin Williams.

9. USG.

B. **Fire Retardant Manufacturer: American Flamecoat, 704-543-0903, 206-789-9404.**

C. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Provide paint products from one or more manufacturers as required to comply with the color/gloss level/product type combinations. The gloss level of manufacturer's product numbers in this specification may not match the required gloss level specified. Adjust manufacturer's product numbers within the same quality line to match the required gloss level.

B. Exterior:

1. Enamel, Gloss Level 5, on Metal (System A):

a. Prime Coat:

(1) Ferrous Metals, Galvanized Metals, and Non-ferrous Metals:

(a) First coat latex metal primer.

(b) Manufacturers: PPG Pitt Tech Primer Finish DTM 90-712.

(2) Precoated Metal (PVDF): Treat painted surfaces with solvent and prime with epoxy.

(a) Solvent Manufacturers: PPG Amercoat "Amerase."

(b) Epoxy Primer Manufacturers: PPG Amercoat "385."

b. Second and Third Coats:

(1) Water-based alkyd enamel, gloss level 5.

(2) Manufacturers: PPG Speedhide WB Alkyd Semi Gloss 6-1610

C. Interior:

1. Enamel, Gloss Level 5, on Metal: Same as Exterior Metal Surfaces (System A).

2. Acrylic, Gloss Level 5, on Concrete Block Surfaces (System E):

a. Prime Coats: Multiple coats may be required such that, prior to any finish coat painting, no unsealed pores can be detected using a 30X microscope.

(1) Acrylic latex interior/exterior block filler.

(2) Manufacturers: PPG Speedhide Masonry Block Filler 6-7.

b. Second and Third Coats:

(1) 100% acrylic latex, gloss level 5, roller- or brush-applied, no spray permitted.

(2) Manufacturers: PPG Speedhide Zero VOC Semi Gloss 6-4510.

3. Acrylic, Gloss Level 5, on Gypsum Plaster Surfaces (System F):

a. Prime Coat:

(1) Acrylic primer.

(2) Manufacturers: PPG Speedhide Zero VOC Latex Sealer 6-4900 Primer-Sealer."

b. Second and Third Coats:

(1) 100% acrylic latex, gloss level 5, roller- or brush-applied, no spray permitted.

(2) Manufacturers: PPG Speedhide Zero VOC Semi Gloss 6-4510.

4.

5. Enamel, Gloss Level 6, on Metal Ladders and Stairs (System G):

a. Prime Coat:

(1) Alkyd metal primer.

(2) Manufacturers: PPG Speedhide Alkyd Primer 6-209

b. Second and Third Coats:

(1) Industrial polyurethane Acrylic Aliphatic enamel, gloss level 6.

(2) Manufacturers: PPG Pitthane 35 Gloss Urethane 95-850.

6. Acrylic, Gloss Level 1, on Gypsum Board Ceilings (System J):

a. Prime Coat, Interiors:

(1) Vinyl acrylic latex primer.

(2) Manufacturers: USG "Sheetrock Brand Primer Surfacer Tuff-Hide."

b. Second and Third Coats:

(1) 100% acrylic latex, gloss level 1.

(2) Manufacturers: PPG Speedhide Zero VOC 6-4510.

(3) Gloss Level 10 @ 85, 5 @ 60.

7. Acrylic, Gloss Level 3, on Gypsum Board Walls and Trim (System K):

a. Prime Coat:

(1) Vinyl acrylic latex primer.

(2) Manufacturers: USG "Sheetrock Brand Primer Surfacer Tuff-Hide."

b. Second and Third Coats:

(1) 100% acrylic latex, gloss level 3. Gloss Level 10 – 20 @ 60.

(2) Manufacturers: Miller Paint Co. "Acro Pure Lo VOC," 1450 Series.

(3) PPG Speedhide Zero VOC Egg Shell 6-4510.

8. Acrylic, Gloss Level 5, on Gypsum Board (System M):

a. Prime Coat:

(1) Vinyl acrylic latex primer.

(2) Manufacturers: USG "Sheetrock Brand Primer Surfacer Tuff-Hide."

b. Second and Third Coats:

(1) 100% acrylic latex, gloss level 5.

(2) Manufacturers: PPG Speedhide Zero VOC Semi-gloss 6-8.

(3) Gloss Level 35 – 55 @ 60.

9. Epoxy, Gloss Level 3, on Gypsum Board (System N):

a. Prime Coat:

(1) Vinyl acrylic latex primer.

(2) Manufacturers: USG "Sheetrock Brand Primer Surfacer Tuff-Hide."

b. Second and Third Coats:

(1) Waterborne polyamide epoxy, gloss level 3.

(2) Manufacturers: PPG Pitt Glaze WB1 Pre Catalyzed WB Epoxy 16-510.

(3) Gloss at 60°: 10 to 25 units. Sheen at 85°: 10 to 35 units.

10. Clear Coating, Gloss Level 4, on Wood (CC):

a. AWI System post-catalyzed lacquer for closed grain woods.

b. Prime Coat:

(1) Catalyzed lacquer, thinned 50%.

(2) Manufacturers: R.J. McGlennon "84 Series LVH-101 Low VOC Chemlac."

c. Second and Third Coats:

(1) Catalyzed lacquer, gloss level 4.

(2) Manufacturers: R.J. McGlennon "84 Series LVH-101 Low VOC Chemlac."

11. Limewash on Concrete Block:

a. Water-base coating on porous substrate.

b. Minimum three coats, brush applied only. Additional coats may be required such that no unsealed pores can be detected using a 30X microscope.

c. Manufacturer: Sydney Harbor Paint Company “Interno Lime Wash.”

12. **Wood Fire Retardant: American Flamecoat, Inc., 704-405-2550, "Flame Control 122W."**

PART 3 EXECUTION

3.1 PROTECTION

A. Protection of Surfaces and Cleaning: Protect floors and other adjoining surfaces from paint droppings and spillage of materials.

3.2 SURFACE PREPARATION

A. General:

1. Carefully examine all surfaces over which finish is to be applied. Any surface not suitable for the proper finish which cannot be rectified by light sanding, cleaning, etc., must be brought to the attention of the Architect before any materials are applied. Do not proceed with the work until such conditions have been rectified. Beginning work denotes acceptance of substrates.

2. All surfaces shall be thoroughly dry before any finish is applied and application shall not be done in severely cold weather except under instructions from the Architect.

B. Wood:

1. Prime and back prime all woodwork immediately upon receipt at the job. Required for all wood trim. One coat sealer compatible with finish coats on transparent finished work. **Coordinate sequence of fire retardant treatment with prime and finish coats.**

2. Properly sand wood surfaces before any finish is applied. Knots or sappy places shall be given one coat of shellac at least twelve hours before being painted. Shellac is not to be used on any other surfaces. Use putty or wood filler of the same shade as the finish coat in filling nail holes, checks, and other blemishes, then lightly sand smooth as soon as filler has hardened.

C. Metal:

1. All metal installation shall be made complete and ready for painting. Touch-up shop or prime coats that have been damaged with material of the same type and quality as originally used on the shop coat. Thoroughly remove all rust previous to this priming operation.

2. Etch galvanized metal with phosphoric acid solution prior to applying primer.

3. Prepare substrate and apply coatings in strict adherence with coating manufacturer's instructions.

D. Concrete Block: Remove dust and dirt from all surfaces.

E. Gypsum Board Surfaces: Paint shall not be applied to any surface until it is thoroughly dry and cured. Prime surfaces that show hot spots or alkali in order to prevent such blemishes from showing through the paint. Brush off all loose particles or crystals which may have formed.

3.3 APPLICATION

A. Employ workers skilled in the application of paint products specified.

B. When paint mixing is required on the job, perform mixing on the premises immediately before applying, and thoroughly stir and strain all materials. Do not change or reduce any material in any way except as specified by paint manufacturer.

C. Except where method of application is specifically noted, all materials shall be applied by brush or roller. Application by spray only where approved by the Architect. All spray application shall be by airless method only.

D. Coverage and Workmanship:

1. Assume all responsibility for paint coats applied over surfaces and undercoats which have not been inspected and approved by Architect. Apply any additional coats of paint, as directed by Architect, where surface preparation and undercoats have not been approved before painting. Make finished work match approved samples.

2. The visible parts of the structure behind grilles and louvers are to be painted with flat black enamel.

E. Drying: Apply paints to surfaces at atmospheric temperatures of not less than 50°F and maintain this minimum temperature throughout the drying time. Ensure adequate ventilation in all painted spaces. Allow sufficient time to elapse as recommended by the manufacturer, between successive coats, to permit proper drying. Modify as necessary to suit adverse weather conditions.

F. Exterior:

1. Metal: All exposed metal items including metal doors and frames, structural and miscellaneous steel, flashings, plumbing vents, mechanical equipment, pipe and electrical conduits are to receive a total of three coats of material, as specified above. Shop coat to be considered one coat; touch-up as required.

G. Interior:

1. Metal Enamel: All surfaces are to receive three coats (total including prime coat) of materials as specified above. All exposed interior metal, including but not limited to, door frames, doors, electrical plaster rings, grilles, railings, registers, conduit, pipe, mechanical ducts, etc., in finished room areas are to be painted as called for above.

2. Gypsum Board: All surfaces shall receive three coats of material, as specified above including walls behind markerboards, acoustical panels, and other surface applied accessories. Remove dust from surfaces, clean off or seal all stains and marks which may show or bleed through finishes.

3. Concrete Block: Apply three finish coats of material specified above. Brush apply only.

4. Clear Coating: For wood doors and other wood surfaces where scheduled. One coat each of primer, undercoating, and finish coat. Paint top, bottom, and edges of door the same number of coats as the door faces after doors have been fitted.

5. Epoxy Finish on Gypsum Board: Apply one prime coat and two finish coats using manufacturer’s application instructions.

6. **Wood Fire Retardant Treatment: Treat wood paneling and Division 6 linear wood ceiling wood with fire retardant treatment by spray or dip coating in conformance with manufacturer's instructions. Coordinate sequence of application of other coatings and ensure that all materials are compatible before applying fire retardant treatment.**

3.4 COLOR SCHEDULE

A. PNT Colors: Refer to Division 9 Section "Finish Legend."

END OF SECTION

GRAFFITI RESISTANT COATING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, preparation, materials, services, and equipment required for the application of graffiti resistant coatings.

1.2 SYSTEM DESCRIPTION

A. The graffiti resistant coating product specified is selected as a standard of quality and based on manufacturers recommendations for execution. Application procedure and coverage rates must be in conformance with effectiveness of testing samples submitted, recommendation of application rates suggested, approved manufacturers standards and as a minimum, that specified herein.

B. Non-sacrificial, will withstand repeated cycles of graffiti tagging and removal with no requirement to reapply the sealant. May enhance or darken some substrates. Will not form a surface film or gloss. Inorganic, it is not affected by UV rays, salts, acid rain, etc. Breathable, it allows moisture vapor to escape while preventing liquid penetration. Flexible, it bridges hairline cracks and allows for building movement. Provides waterproofing protection as well as a graffiti barrier.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1, Section "Submittal Procedures."

B. Product Data: Submit manufacturer’s product data sheets for the specified graffiti resistant coatings and cleaners. Submit description for protection of surrounding areas and non-masonry surfaces, surface preparation, application, and final cleaning.

C. Applicator Qualifications: Submit qualifications of applicator; stating applicator has a minimum of 3 years experience using the specified or similar products. Provide a list of several most recently completed projects, including project name and location, names of owner and architect, and description of products used, substrates, and method of application.

D. Environmental Regulations: Submit applicable environmental regulations.

E. VOC Certification: Submit certification that graffiti resistant coatings furnished comply with regulations controlling content of volatile organic compounds (VOC).

1.4 QUALITY ASSURANCE

A. Applicator Qualifications:

1. Experience in the application of the specified or similar products.

2. Employs persons trained for the application of the specified products or compatible products.

B. Pre-Application Meeting: Convene a pre-application meeting two (2) weeks before the start of application of graffiti resistant coatings. Require attendance of parties directly affecting work of this section, including the Contractor, Architect, applicator, and manufacturer's representative. Review environmental regulations, test panel procedures, protections of surrounding areas and non-masonry surfaces, surface preparation, application, field quality control, final cleaning, and coordination with other work.

1.5 ENVIRONMENTAL REGULATIONS

A. Comply with applicable federal, state, and local environmental regulations.

1.6 TEST PANELS

A. Before full-scale application, review manufacturer's product data sheets to determine the suitability of each product for the specific surfaces. Apply each graffiti resistant coating to test panels to determine appropriate strengths, coverage rates, compatibility, effectiveness, surface preparation, application procedures, and desired results.

B. Apply graffiti resistant coatings to test panels in accordance with manufacturer's written instructions. Allow 5 days curing time prior to applying graffiti tag paint to test panels. Apply graffiti paint to test panels and allow at least 24 hours or longer for paint to cure. Apply cleaner to evaluate for ease of graffiti removal. Repeat cycles of cleanings as directed by Architect. Do not begin full-scale application until test panels are inspected and approved by the Architect.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to the job site in original, tightly sealed, unopened containers, with labels clearly identifying product name and manufacturer. Verify that the product matches that of the original sample applied on the test panel.

B. Storage and Handling: Store containers upright in a cool, dry place. Keep away from sparks and open flame. Store and handle materials in accordance with manufacturer's written instructions.

1.8 PROJECT CONDITIONS

A. Surface Preparation: Contractor or applicator shall be responsible for providing a clean, dry substrate free from oil, dirt, grease, efflorescence, form release agents or any other coating, which may inhibit penetration and adhesion of graffiti resistant coating. Substrate must be completely dry prior to applying product.

B. Environmental Requirements:

1. Temperature: Product may be applied at any temperature providing that there is no frozen moisture present in the substrate. When applied at temperatures below 40 degrees Fahrenheit the product may cure at a slower rate. Optimal temperature range for application is between 40° F (5° C) or below 95° F (35° C).

2. Do not apply material if the substrate is wet or contains frozen moisture. Allow substrate to dry for a minimum of 48 hours after rain or power washing.

3. Do not apply material during inclement weather or if precipitation is expected within 12 hours.

4. Do not use spray methods of application under windy conditions.

C. Protection:

1. Special precautions should be taken to avoid fumes from entering the building being treated. Heating and air conditioning, ventilation systems, and fresh air intakes should be turned off and covered.

2. Protect shrubs, metal, glass, vehicles, and other building hardware from overspray.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Professional Products of Kansas, Inc., 800/676-7346.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 GRAFFITI RESISTANT COATINGS

A. Professional® Water Sealant & Anti-Graffitiant, Super Strength: First coat in the two-coat process. Depending on the porosity of the substrate, it may be used for the second coat as well. Penetrating silicone rubber graffiti resistant coating for use on vertical brick.

1. Form: Liquid.

2. Color: Clear.

3. Active Substance: RTV Silicone Rubber.

4. Percent Active Material: 15%.

5. Flash Point: 105°.

B. Professional® Water Sealant & Anti-Graffitiant, Extra Strength: May be used as the second coat in the two-coat process. Porosity of substrate is the determining factor.

1. Form: Liquid.

2. Color: Clear.

3. Active Substance: RTV Silicone Rubber.

4. Percent Active Material: 8%.

5. Flash Point: 105°.

2.3 CURED PROPERTIES

A. Coating must penetrate the surface of the material to which it is applied to be effective. The active ingredients react to form silicone rubber, which remains below the surface and prevents water from penetrating while permitting water vapor transmission. The silicone rubber retains its characteristic 400% elongation, which allows for bridging of hairline cracks, expansion and contraction, building movement and extremes of temperature.

B. Coating is unaffected by ultraviolet light, ozone, water, deicers and acids. It allows moisture vapor to escape while preventing liquid penetration. It cures to a clear, flat durable finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify the following:

1. The required joint sealants have been installed.

2. New masonry and mortar has cured a minimum of 28 days.

3. Surface to be treated is clean, dry, and contains no frozen moisture.

4. Environmental conditions are appropriate for application.

3.2 PROTECTION

A. Protect surrounding areas, glass, landscaping, building occupants, pedestrians, vehicles, and non-masonry surfaces during the work from contact with graffiti resistant coatings.

B. Special precautions should be taken to prohibit fumes from entering the building being treated. Heating and air conditioning, ventilation systems and fresh air intakes should be turned off and covered.

3.3 SURFACE PREPARATION

A. Clean all dirt, oil, grease, mold, mildew, efflorescence, form release agents or any other coating or material from surfaces that interfere with penetration, performance, adhesion, or aesthetics of graffiti resistant coatings. Rinse thoroughly, using pressure water spray to remove cleaner residues. Allow surfaces to dry completely before application of graffiti resistant coatings.

B. Repair, patch, and fill all cracks, voids, defects, and damaged areas in surface as approved by the Architect. Allow repair materials to cure completely before application of graffiti resistant coatings.

C. Seal all open joints.

D. Allow new masonry and concrete construction and repointed surfaces to cure for a minimum of 28 days before application of graffiti resistant coatings.

3.4 APPLICATION

A. Apply graffiti resistant coatings to substrates in accordance with manufacturer's written instructions, environmental regulations, and application procedures determined from the test panel results approved by the Architect. Graffiti protection requires a two-coat application. In most cases, the first coat will be Super Strength. The second coat will be either Super or Extra, depending on the porosity of the substrate.

B. Apply to clean, dry, cured, and properly prepared surfaces approved by Architect.

C. Apply material as shipped by the manufacturer. Do not dilute.

D. Do not apply to below-grade surfaces.

E. Do not apply to painted surfaces.

F. Do not apply to compensate for structural or material defects in substrates.

G. Do not apply to substrates such as asphalt or polystyrene, which may be affected by the solvent carrier.

H. Apply material using a high-volume, low pressure, pump-up sprayer (between 40-50 psi), with solvent resistant fittings, foam roller, or brush of natural bristle or foam.

I. Apply in a flood coat, from top to bottom, being sure to obtain a 4 to 6 inch rundown of product from the point where the spray makes contact with the surface. Work all the way down the building covering the rundown as you go. Avoid excessive overlapping. Allow first coat to dry to the touch prior to applying second coat. Apply the second coat the same as the first coat, by flood coating from the top down.

3.5 FIELD QUALITY CONTROL

A. Inspection: Inspect the graffiti resistant coating work with the contractor, Architect, applicator, and Professional Products of Kansas representative, and compare with test panel results approved by the Architect. Determine if the graffiti resistant coatings suitably protect the substrates. Allow the test panel to cure for 5 days prior to putting the graffiti paint on for testing purposes.

B. Manufacturer's Field Services: Provide the services of a manufacturer's authorized field representative to verify specified products are used; protection, surface preparation, and application of graffiti resistant coatings are in accordance with the manufacturer's written instructions; and the test panel is approved by the Architect.

3.6 FINAL CLEANING

A. Upon completion of all work covered in a specification, the Contractor shall remove all equipment, material and debris, leaving the area in an undamaged and acceptable condition.

Dispose of graffiti resistant coating containers according to state and local environmental regulations.

B. Repair, restore, or replace to the satisfaction of the Architect, all materials, landscaping, and non-masonry surfaces damaged by exposure to graffiti resistant coatings.

END OF SECTION

VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, and equipment necessary for the installation of markerboards.

1.2 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings.

C. Samples of materials including markerboard writing surface color and sheen samples for selection by Architect.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Markerboards **and Dry Erase Wall Panels:**

1. Claridge.

2. Steelcase Polyvision.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MANUFACTURED UNITS

A. MB-1, Markerboards:

1. Pre-framed 24 gauge steel sheet coated with markerboard writing surface and laminated to manufacturer’s standard backing with aluminum foil moisture protection balance sheet.

2. 1-inch display rail with natural cork insert and four map hook/paper holders per 8-lin.ft. of board on each unit.

3. Provide all required mounting brackets and fasteners for complete installation.

4. Writing surface color to match Polyvision "6100H White."

5. Manufactured Units:

a. Claridge "Series 4" frame with chalk tray and "LCS-II" writing surface.

b. Steelcase “Polyvision 100 Series” frame with chalk tray and E3 Environmental Ceramicsteel markerboard writing surface.

B. **Dry Erase Wall Panels:**

1. **Polyvision “E3 Ceramicsteel” 24 gauge steel sheets, floor to ceiling wall application.**

2. **Writing surface color Polyvision "6100H White."**

C. **Glass Whiteboards:**

1. **1/4-inch thick tempered glass, eased corners, polished edges, magnetic.**

2. **Size: As detailed.**

3. **Marker Tray: Tempered glass, 4-inches wide, 12-inches long.**

4. **Mounting: Two stainless steel standoffs.**

5. **Color: Custom as selected by Architect.**

6. **Manufactured Units: Clarus Glassboards, 888-813-7414.**

PART 3 EXECUTION

3.1 INSTALLATION

A. If electrical, mechanical, or any other type of control or device occurs in the area that is to receive markerboard, immediately notify the Architect. Do not cut holes in markerboard without specific instructions from the Architect.

B. Markerboards:

1. Verify that blocking specified in Divisions 6 is installed in wall framing for installation of mounting rails.

2. Set hanging rail to hang board at approved height; chalk tray to be 34-inches above floor unless otherwise shown.

3. Hang boards and install all accessories.

4. Wash boards after installation and condition as required to make ready for use.

C. **Wall Panels: Mount dry erase wall panels to walls with adhesive, following wall panel manufacturer’s printed installation instructions.**

END OF SECTION

PANEL SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the installation of interior and exterior one-piece polymer plaque signs.

1. Work of this Section includes:

a. Fire/life/safety and code-required signs.

b. Room identification signs.

c. Fabrication, installation and any necessary sign permits for all signs in this package.

d. Costs related to artwork shall be considered a part of the Work for this Section.

1.2 DEFINITIONS

A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section “Submittal Procedures.”

B. Shop Drawings:

1. Indicate sign layout, typical letter spacing, letter profile, dimensions, and connection details.

2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.

C. Product Samples:

1. Submit one full size polymer sign.

2. Acceptable samples may be incorporated in the Work.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of polymer finishes beyond normal weathering.

b. Deterioration of embedded graphic image colors and sign lamination.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Laminated and One-Piece Polymer Signs:

1. Center Pointe Signs, 503-259-8855.

2. Meyer Sign Co. of Oregon, Inc., 503-620-8200.

3. Architectural Metalcrafters, Inc., 503-557-7686.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section “Product Requirements.”

2.2 FABRICATION OF SIGNS

A. One-Piece Polymer Plaque Signs:

1. Plaque Sizes: As detailed.

2. Background Color: Color as selected by Architect from manufacturer’s standard colors.

3. Copy: As detailed.

4. Sign Style: Custom.

5. Letter Style: Futura.

6. Letter Sizes: Height as detailed, 1/16-inch raised depth.

7. Letter Color: White.

8. Letter Spacing: Normal.

9. Copy Position: As detailed.

10. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.

11. Mounting Method:

    a. 3M VHB adhesive tape, vertical strips. Provide anodized aluminum Chemetal plate on opposite glass side of signs mounted on glass. Back plate shall match sign size.

    b. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated. Factory paint brackets in color matching background color of panel sign.

12. Sign Corners: Square.

2.3 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

PART 3 EXECUTION

3.1 PREPARATION

A. Verification of Conditions: Starting installation constitutes acceptance of existing substrate conditions.

3.2 INSTALLATION

A. Installation of Polymer Signs:

1. Locate on face of substrate as indicated on Drawings.

2. Secure with tape or other mounting method appropriate for the substrate and environment.

3. Back plates for signs mounted on glass shall align with sign edges.

3.3 COMPLETION

A. Adjusting Defective Work:

1. Relocate misplaced signs.

2. Replace defective or damaged sign components prior to Substantial Completion.

B. Final Cleaning: Clean sign face within seven days prior to Substantial Completion.

PANEL SIGNAGE

END OF SECTION

PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services required for the installation of reinforced composite plastic toilet compartments.

1.2 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings showing plan of installation, elevations, and anchorage or support details.

C. Product data for hardware and accessories.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years experience in manufacture of solid plastic toilet compartments with products in satisfactory use under similar service conditions.

B. Installer Qualifications: Minimum 5 years commercial experience in work of this Section.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard 25 year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship. Manufacturer's standard 1 year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product Manufacturer: Bobrick “Sierra Series” 1092.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 FABRICATION

A. Solid Color Reinforced Composite (SCRC) Toilet Partitions: Bobrick Sierra Series.

1. Design Type: Standard Height.

a. Door/Panel Height: 58 inches (147 cm).

b. Floor Clearance: 12 inches (30 cm).

2. Mounting: Floor-mounted, overhead-braced with satin finish, extruded anodized aluminum headrails, 0.065 inch (1.65 mm) thick with anti-grip profile.

   a. Stile Standard Height: 70 inches (178 cm).

B. Solid Color Reinforced Composite (SCRC) Urinal Screens: Bobrick Sierra Series.

1. Mounting Configuration: Wall-hung.

2. Screen Height: 42 inches (107 cm) with 18 inches (46 cm) floor clearance.

C. Materials: Solid color reinforced composite (SCRC) material for stiles, panels, doors, and screens with Bobrick GraffitiOff coating, thermoset and integrally fused into homogenous piece.

1. Composition: Dyes, organic fibrous material, and polycarbonate/phenolic resins.

2. Surface Treatment: Non-ghosting, graffiti resistant surface integrally bonded to core through a manufacturing steps requiring thermal and mechanical pressure.

3. Edges: Same color as the surface.

4. Color: As selected by Architect from manufacturer's standard SierraSeries range.

D. Performance Requirements:

1. Graffiti Resistance (ASTM D 6578): Passed cleanability test; 5 staining agents.

2. Scratch Resistance (ASTM D 2197): Maximum load value exceeds 10 kilograms.

3. Impact Resistance (ASTM D 2794): Maximum impact force exceeds 30 inch-pounds.

4. Smoke Developed Index (ASTM E 84): Less than 450.

5. Flame Spread Index (ASTM E 84): Less than 75.

6. National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class B.

7. International Building Code: Class II.

E. Finished Thickness:

1. Stiles and Doors: 3/4 inch (19 mm).

2. Panels and Screens: 1/2 inch (13 mm).

F. Stiles: Floor-anchored stiles furnished with expansion shields and threaded rods.

1. Leveling Devices: 7 gauge, 3/16 inches (5 mm) thick, corrosion-resistant, chromate-treated, double zinc-plated steel angle leveling bar bolted to stile; furnished with 3/8 inch

(10 mm) diameter threaded rods, hex nuts, lock washers, flat washers, spacer sleeves, expansion anchors, and shoe retainers.

2. Stile Shoes: One-piece, 22 gauge (0.8 mm), 18-8, Type 304 stainless steel, 4 inch (102 mm) height; tops with 90 degree return to stile. One-piece shoe capable of adapting to 3/4 inch (19 mm) or 1 inch (25 mm) stile thickness and capable of being fastened (by clip) to stiles starting at wall line.

G. Wall Posts: Pre-drilled for door hardware, 18-8, Type 304, 16 gauge (1.6 mm) stainless steel with satin finish; 1 inch (25 mm) x 1-1/2 inches (38 mm) x 58 inches high (1473 mm).

H. Anchors: Expansion shields and threaded rods at floor connections as applicable.

I. Hardware: Chrome-plated "Zamak", aluminum, extruded plastic hardware not acceptable.

1. Compliance: Operating force of less than 5 lb (2.25 kg).

2. Emergency Access: Hinges, latch allow door to be lifted over keeper from outside compartment on inswing doors.

3. Materials: 18-8, Type 304, heavy-gauge stainless steel with satin finish.

4. Doorstops: Prevents inswinging doors from swinging out beyond stile; on outswing doors, doorstop prevents door from swinging in beyond stile.

5. Fastening: Hardware secured to door and stile by through-bolted, theft-resistant, pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts. Fasteners secured directly into core not acceptable.

a. Threaded Brass Inserts: Factory-installed; withstand direct pull force exceeding 1500 lb (680 kg) per insert.

6. Clothes Hooks: Projecting no more than 1-1/8 inch (29 mm) from face of door.

7. Door Hardware Type: Institutional hardware.

a. Latching: Track of door latch prevents inswing doors from swinging out beyond stile; on outswing doors, door keeper prevents door from swinging in beyond stile; 14 gauge (2 mm) sliding door latch, 11 gauge (3.2 mm) keeper; latch slides on a shock-resistant nylon track.

b. Hinges: Balanced, with field-adjustable cam to permit door to be fully closed or partially open when compartment is unoccupied. 16 gauge (1.6 mm) stainless steel, self-closing, 3 section hinges.

c. Locking: Door locked from inside by sliding door latch into keeper.

8. Fittings: Institutional hardware:

a. Mounting Brackets: Mounted inside compartment; exposed brackets on exterior of compartment not acceptable with the exception of outswing doors. 18 gauge (1.2 mm) stainless steel and extend full height of panel.

b. U-Channels: Secure panels to stiles.

c. Angle Brackets: Secure stiles-to-walls and panels to walls.

PART 3 EXECUTION

3.1 INSTALLATION

A. Compartment installation by skilled workers approved by manufacturer. Conform to manufacturer's instructions. Horizontal lines level and at correct elevations. Vertical members and lines plumb.

B. Verify and coordinate the proper installation of additional supports, bracing, and blocking in building walls, and floors to receive anchorage fastenings. Drill and tap concealed metal supports to receive machine bolts as required.

C. Use fasteners and anchors suitable for substrate and project conditions.

D. Install units rigid, straight, plumb, and level.

E. Conceal evidence of drilling, cutting, and fitting to room finish.

3.2 ADJUSTING AND CLEANING

A. Set hinges to close or hold open as directed. Clean panels and hardware and adjust hardware for perfect fit and operation. Repair or replace damaged finishes and construction if caused by this work.

END OF SECTION

TOILET ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment and services required for the installation of toilet and bath accessories. Supply in type, size, number and kind necessary to complete the work. Examine the Drawings for locations and any special installation details.

1.2 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings showing detail of any modifications required to suit the installation.

C. Manufacturer's detail sheets showing installation details, listing all necessary parts and accessories, and listing color or finish options unless special finish is specified.

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Specification is based on Bobrick Washroom Equipment and other manufacturers as noted in Paragraph 2.2; Bradley Corp. approved. Baby changing station by Koala Kare Products, 888-733-3456.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Furnish type of accessories for each room as scheduled. Furnish all items with chrome plated or stainless steel finish unless specifically noted otherwise. Furnish scribe filler strips at all mirror installations where overlapping ceramic tile wainscot.

B. Abbreviations: The following abbreviations are listed for identification of accessories in locations as detailed. “B” model numbers are for Bobrick, other manufacturers as noted.

Abbrev.	Item	Model No.
BCS-1	Baby changing station	Koala KB111-SSRE.
GB-1	Grab bar	B-6106.99 x18
GB-2	Grab bar	B-6106.99 x36

GB-3	Grab bar	B-6106.99 x42
MR-1	Mirror	B-290-2448
PTR-1	Paper towel receptacle	B-277
SSS-1	Stainless steel shelf	Royce Rolls HDS 12

Owner Furnished, Contractor Installed

ND-1	Sanitary napkin dispenser	Rochester Midland SSS J6N
NR-1	Sanitary napkin receptacle	Impact Products IMP 1103
PTD-1	Paper towel dispenser	Perrin Craft HF 108-50
SCD-1	Seat cover dispenser	Georgia Pacific 57748
SD-1	Soap dispenser	Deluxe Triad 9352
TPH-1	Toilet paper holder	Vista Jr. 58250

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all accessories in accordance with published standard specifications and manufacturer's recommendations. Verify required installation variations with Architect before proceeding with the work.

B. Verify that walls and surfaces to which accessories are to be mounted are reinforced or provided with backing or blocking for solid anchorage. Provide fasteners long enough to penetrate into solid anchorage. Fastening with toggle bolts, molly screws, or similar fittings not permitted.

3.2 ADJUSTING

A. Damaged Items: Bent, dented, and racked items are not acceptable. Field repairs not permitted. Refinish scratched and abraded finishes equal to original finish and indistinguishable from adjacent surfaces.

END OF SECTION

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, and equipment required for the installation of fire extinguishers with cabinets and automated external defibrillators with cabinets.

1.2 REFERENCES

A. NFPA 10 - Standard for Portable Fire Extinguishers; National Fire Protection Association; 2007.

B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Shop drawings.

C. Manufacturer’s product information.

1.4 REGULATORY REQUIREMENTS

A. Fire Extinguishers: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product Manufacturers:

1. J.L. Industries, div. of J.N. Johnson Co.

2. Larsen’s Manufacturing Company.

3. Amerex Corporation.

4. Philips HeartStart.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Fire Protection Specialties:

1. Cabinets:

a. FEC-1, Semi-Recessed: J.L. Industries "Panorama Model 1037" stainless steel with 3-inch return trim, 6-inch inside tub dimension.

b. Door Style: J.L. Industries "P" identity series, white with black, "Type P42" style, textured obscure acrylic door, white background with black letters.

2. Fire Extinguishers: UL Rating 2A10BC for all applications except kitchen spaces, maximum 6-inch cylinder diameter. Provide one in each cabinet.

B. Rescue Specialties:

1. Automated External Defibrillator (AED): Philips HeartStart FRx Defibrillator.

a. Carry Case, Plastic Waterproof Shell.

b. 2 HeartStart SMART Pads II (1 Set).

c. 1 68-PCHAT Fast Response Kit.

d. 2 M5070A Battery for HeartStart Defibrillator.

e. 1 Infant/Child Key.

2. Cabinet: Philips semi-recessed defibrillator cabinet PFE7023D:

a. Construction: Made of heavy-gauge steel, and large enough to accommodate additional medical supplies such as oxygen. This cabinet can also be connected to an internal security system so that a more coordinated emergency response can be mobilized centrally.

b. Combination of audible and flashing light alarm.

c. Dimensions:

(1) Inside compartment: 14" W x 22" H x 6" D

(2) Footprint on wall: 16.5" W x 24.5" H x 2.5" D

PART 3 EXECUTION

3.1 INSTALLATION

A. Install cabinets in accordance with manufacturer’s instructions. Refer to Drawings for wall construction and thickness for verification of requirements of semi-recessed cabinets and

hardware and fasteners for installation. Set cabinets neatly and securely in place, plumb and true to building lines.

END OF SECTION

SAFETY AND TIE-BACK ANCHORS

PART 1 GENERAL

1.1 SUMMARY

A. Work of this section includes the design, supply and installation of safety and tie-back anchor system of fall restraint and fall arrest for worker safety anchored to wood frame and steel frame roof construction.

B. Related Sections:

1. Division 5 Section "Structural Steel."

2. Division 6 Section “Rough Carpentry.”

3. Divison 7 Section “TPO Single Ply Membrane Roofing.”

4. Division 7 Section "Flashing and Sheet Metal."

5. Division 7 Section "Joint Sealants."

1.2 REFERENCES

A. AISC publication "Load and Resistance Factor Design Specification for Structural Steel Buildings."

B. AISI publication "Specification for Design of Cold-Formed Steel Structural Members (1986 & 1989 Addendum)."

C. AWS D1.1 Structural Welding Code - Steel.

D. ANSI/IWCA I-14.1 Window Cleaning Safety Standard (General Industry Safety Standard, International Window Cleaning Association).

1.3 SYSTEM DESCRIPTION

A. General: Provide structural fall restraint and fall arrest system capable of withstanding loads and stresses within limits and under conditions specified in OSHA and other applicable safety codes. Provide fall prevention anchors permanently attached to roof structure.

B. Design Requirements: Anchors and accessories comprising system of following types:

1. Roof anchors, spaced as indicated, for safety snap connection by individual workers cable of withstanding a 5,000 lb. load or safety factor of 2.

C. Performance Requirements: System and components tested for resistance of following loads:

1. Fall Restraint: 4 persons simultaneously applied.

2. Fall Arrest: 1 person.

3. Design tie-back anchors to resist at least 5000 lbf applied in any direction at a height of 12 inches above top of roof deck.

1.4 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product Data: For each type of fall prevention device specified, including manufacturer's standard fabrication details and installation instructions.

C. Shop Drawings: Show layout, profiles, and anchorage details. Include structural analysis data.

D. Maintenance Data: Written instructions for maintenance of fall prevention safety devices to be included in the operation and maintenance manual specified in Division 1.

E. Welding certificates.

F. Test Reports:

1. Indicate compliance with required performance requirements.

2. On shop- and field-welded connections. Include data on types of tests conducted.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm having at least 10 years continuous experience in manufacturing fall safety equipment similar to systems specified and exhibiting records of successful in-service acceptability and performance.

B. OSHA Standards: Comply with Occupational Safety and Health Administration Standards for the Construction Industry 29 CFR § 1926.500 Subpart M (Fall Protection), and with applicable State Administrative Code safety standards for Fall Restraint and Fall Arrest.

C. Welding: Qualify procedures and personnel for field-welding according to American Welding Society’s AWS D1.1-00, Structural Welding Code – Steel.

D. Loading And Safety Assurance: Work of this Section to meet the requirements of governing codes and jurisdiction and to comply with properly engineered loading and safety criteria for the intended use.

E. Insurance: Manufacturer to carry specific liability insurance (products and completed operations) in the amount of $2,000,000 to protect against product/system failure.

F. Testing: Perform quality control tests for each system per manufacturer's requirements.

1.6 COORDINATION

A. Coordinate installation of structural deck to meet requirements of roof anchor manufacturer:

1. Wood Deck: Minimum 3/4-inch CDX Ext. plywood sheathing, or provided with additional wood blocking per manufacturer’s instructions.

B. Coordinate installation of structural deck reinforcements and anchorages to receive fall prevention anchors.

C. Coordinate placement of roofing system insulation and flashings to ensure water-tight integrity of roof.

1.7 REGULATORY REQUIREMENTS

A. Comply with following OSHA regulation:

1. 1910, Subpart D (Walking and Working Surfaces).

2. Appendix C to 1910 Supart F (Personal Fall Arrest Sytems).

3. "OSHA Ruling on Window Cleaning by Bosun's Chair" Memorandum to Regional Administrators from P.K. Clark, Director, Directorate of Compliance Programs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Specified components are manufactured by Guardian Fall Protection Inc., 26513 79th Ave S, Kent WA 98032, phone 800-466-6385.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Steel Plates, Bars: ASTM A36/A36M-01 carbon structural steel.

B. Steel Pipe: ASTM A53/A53M-02, Schedule 80, welded and seamless.

C. Bronze Castings: ASTM B584-00 copper alloy sand castings, Alloy UNS No. C86500 (No. 1 manganese bronze).

D. Coating: Hot-dip galvanized after fabrication per ASTM A123/A123M-02.

E. Cable: Steel wire cable, 0.375 inch diameter.

F. Accessories: Anchors and fasteners tested for substrate and structure assembly and approved by fall protection device manufacturer.

1. ITW Buildex by Illinois Tool Works Inc.

2. Rawl by BPB Rawlplug.

2.3 MANUFACTURED ASSEMBLIES

A. Standard Roof Anchors: Guardian CB Series anchors, each a welded assembly consisting of top U-bolt eyelet, pipe upright, and base plate.

1. Steel Upright: 2-1/2-inch ID steel pipe, height varies to suit roof construction.

2. Steel U-Bolt: 1/2-inch cold rolled steel bar, bent to 2-inch clear diameter U-shape.

3. Base Plate: 3/8-inch steel plate punched with holes for attachment to roof deck.

4. Model Numbers:

a. Guardian CB-12 Anchor Point with Attached Pass-Through Top.

5. Roof Structure Types:

a. Plywood deck over wood frame.

b. Steel deck over steel frame.

B. Lifeline: Continuous steel cable as tested by fall prevention device manufacturer to permit worker mobility and safety.

2.4 FINISH

A. Standard Roof Anchor Finish: Hot Dipped Galvanized.

1. Galvanized: Hot-dip galvanized after fabrication per ASTM A123/A123M-02.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine framing and substrate and verify conditions comply with structural requirements for system performance.

B. Notify Architect of unsatisfactory conditions and improper coordination. Proceed with installation of roof anchors only after verifying conditions are satisfactory.

3.2 INSTALLATION

A. Install equipment in accordance with approved shop drawings and manufacturer's recommendations.

B. Co-ordinate installation with work of related trades.

C. Provide on-site inspection and supervision of installation by factory-trained representative.

3.3 TESTING

A. All anchors relying upon chemical adhesive fasteners to be 100% tested on site using load cell test apparatus in accordance with manufacturer's recommendations.

B. Load cell test to apply minimum 5,000 lb. load without detachment or fracture occurring.

C. Replace damaged or malfunctioning items.

3.4 DEMONSTRATION

A. Instruct Owner's designated safety engineer in proper use of fall prevention safety devices.

END OF SECTION

ROLLER SHADES

PART 1 GENERAL

1.1 SUMMARY

A. Furnish labor, material and equipment necessary for the installation of roller shades as detailed for manually operated sunscreen roller shades.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. National Fire Protection Association (NFPA).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section “Submittal Procedures.”

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.

3. Storage and handling requirements and recommendations.

4. Mounting details and installation methods.

C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, and relationship to adjacent work.

D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.

E. Selection Samples: For each finish product specified, one set of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shadecloth sample and aluminum finish sample as selected. Mark face of material to indicate interior faces.

G. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, and instructions for operating hardware.

H. Field Samples: Install large size sample (minimum of 2-feet x 3-feet) of selected fabric for final verification of color, weave, and density in window opening as directed by Architect.

I. Warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.

B. Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.

C. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

D. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

E. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years.

F. Mock-Up: Provide a mock-up of one roller shade assembly for evaluation of mounting, appearance and accessories.

1. Locate mock-up in window designated by Architect.

2. Do not proceed with remaining work until, mock-up is accepted by Architect.

1.5 DELIVERY, HANDLING, AND STORAGE

A. Deliver shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

A. Roller Shade Hardware, Chain and Shadecloth ~~(except EcoVeil)~~: Manufacturer's standard non-depreciating twenty-five year limited warranty.

~~1. EcoVeil standard non-depreciating 10-year limited warranty.~~

B. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. "MechoShade" by MechoShade Systems, 718/729-2020.

B. Nysan Shading Systems, Ltd., 403/204-8676.

C. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 APPLICATION/SCOPE

A. Manual operating, chain drive, sunscreen roller shades in all exterior windows of rooms and spaces shown on the Drawings to receive manual shades.

B. **SH 1: Manual operating, chain drive, sunscreen roller shades in all exterior windows of rooms and spaces shown on the Drawings to receive manual shades.**

1. **MechoShade "Mecho 5."**

2.3 SHADE CLOTH

A. Visually Transparent Single-Fabric Shadecloth: MechoShade Systems, Inc., ThermoVeil group, single thickness non-raveling 0.030-inch (0.762 mm) thick vinyl fabric, woven from 0.018-inch (0.457 mm) diameter extruded vinyl yarn comprising of 21 percent polyester and 79 percent reinforced vinyl, in colors selected from manufacturer's available range.

1. **[Dense Linear Weave: "1000 series", 3 percent open, dense linear-weave pattern.]**

2. Color: Selected from manufacturer's standard colors.

3. Shadecloth shall meet requirements of FS CCC-C-521E for fire retardancy, NFPA 701 Small Scale, or NFPA 701 Large Scale requirements. Shadecloth seconds or shadecloth manufactured using reprocessed materials are not acceptable.

B. Environmentally Certified Shadecloth: MechoShade Systems, Inc., EcoVeil group, 1550 Series, fabricated from TPO for both core yarn and jacket, single thickness, non-raveling 0.017 inch thick fabric.

1. Weave: 3 percent open, Dense Basket Weave.

2. Color: As selected by Architect from manufacturer's full color range.

2.4 SHADE BAND

A. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.

1. Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.

2. Shade band and Shade Roller Attachment:

a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Roller tubes less than 1.55 inch (39.37 mm) in diameter for manual shades are not acceptable.

b. Provide for positive mechanical engagement with drive / brake mechanism.

c. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.

d. Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.

e. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets are not acceptable.

2.5 SHADE FABRICATION

A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.

B. Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch (3.18 mm) in either direction per 8 feet (2438 mm) of shade height due to warp distortion or weave design. Fabricate hem as concealed hemtube.

C. Provide battens in standard shades as required to assure proper tracking and uniform rolling of the shadebands. Contractor shall be responsible for assuring the width-to-height (W:H) ratios shall not exceed manufacturer's standards or, in absence of such standards, shall be responsible for establishing appropriate standards to assure proper tracking and rolling of the shadecloth within specified standards. Battens shall be roll-formed stainless steel or tempered steel, as required.

D. Battens shall be roll formed of stainless steel or tempered steel and concave to match the contour of the roller tube.

E. Batten pockets shall be self-colored fabric front and back RF welded into the shadecloth. A self-color opaque liner shall be provided front and back to eliminate any see through of the batten pocket that shall not exceed 1-1/2 inches (38.1 mm) high and be totally opaque. A see-through moiré effect, which occurs with multiple layers of transparent fabrics, shall not be acceptable.

2.6 COMPONENTS

A. Access and Material Requirements:

1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.

2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.

3. Use only Delrin engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester will not be acceptable.

B. Manual Operated Chain Drive Hardware and Brackets:

1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.

2. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.

3. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel or heavier as required to support 150 percent of the full weight of each shade.

4. Drive Bracket / Brake Assembly:

a. MechoShade Drive Bracket model M5 shall be fully integrated with all MechoShade accessories.

b. M5 drive sprocket and brake assembly shall rotate and be supported on a welded 3/8 inch (9.525 mm) steel pin.

c. The brake shall be an over -running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. (22 kg) in the stopped position.

d. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated.

Products that require externally applied lubrication and or not permanently lubricated are not acceptable.

e. The entire M5 assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.

5. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. (41 kg) minimum breaking strength. Nickel plate chain shall not be accepted.

C. Roller Tube assembly:

1. Roller tube of one piece extruded aluminum tube, with 10 micron thick clear anodized coating, at the manufacturer's recommended engineered diameter and wall thickness for maximum allowable deflection of L/700; mill finish aluminum tubes not acceptable.

2. The roller tube shall be extruded with provision made for mechanical engagement with the operator and drive assembly.

3. The extrusion shall have various channels to accept fabric attachment spline. The spline and slot reinforces the tube and retains the fabric and operating system.

4. The spline shall be an extruded vinyl profile, welded to the fabric band or panel, such that removal and re-installation of the fabric band or panels shall be without removing the roller tube and hardware. Fabric bands or panels must be replaceable on site. Attachment of the fabric to the tube with double-sided adhesive tapes, adhesives, staples or rivets not acceptable.

D. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

E. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range, unless otherwise indicated.

F. Aluminum Finishes:

1. All exposed aluminum shall be clear anodized oxide finish according to AA-M12C22A31.

2. Unexposed aluminum: Mill finish.

2.7 ACCESSORIES

A. Roller Shade Pocket for recessed mounting in acoustical tile, or drywall ceilings as indicated on the Drawings.

1. Provide either extruded aluminum and or formed steel shade pocket, sized to accommodate roller shades, with exposed extruded aluminum closure mount, tile support and removable closure panel to provide access to shades.

    a. Provide "Vented Pocket" such that there will be a minimum of four 1 inch (25.4 mm) diameter holes per foot allowing the solar gain to flow above the ceiling line.

PART 3 EXECUTION

3.1 EXAMINATION

A. Take field measurements prior to fabrication to ensure fit.

3.2 INSTALLATION

A. Install work by manufacturer's skilled tradesmen and installed in strict accordance with manufacturer's recommendations.

B. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow proper clearances for window operation hardware.

C. The fabric shall be pre-measured and manufactured off-site.

3.3 ADJUSTING AND CLEANING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

B. Adjust shade and shade cloth to hang flat without buckling or distortion.

C. Clean shades and exposed components.

D. Replace work which cannot be satisfactorily repaired, adjusted or cleaned.

E. Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

END OF SECTION

SITE FURNISHINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Exterior Benches.

B. Bicycle racks.

C. Litter Receptacles.

D. Trench Drain Grates.

E. Deck Drain Grate.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Mounting surface for bicycle racks.

1.3 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.

1.4 COORDINATION

A. Coordinate with other trades affecting and affected by work of this Section.

1.5 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 BENCH

A. Model/Manufacturer: Wellspring Bench by Landscape Forms.

B. Size: 48 inches long and 72 inches long.

C. Style: Backed with Arms, no intermediate arms, refer to Site Plan for locations.

D. Mounting: Surface mounted.

2.2 BICYCLE RACK

A. Materials:

1. Hoop Rack: 2-3/8" OD Schedule 40 steel pipe; 18" wide x 36" tall.

2. Base Plate / Rail: 3" x 3/8" flat bar with 6-8 holes for mounting 9/16" in diameter

3. Color: Powercoated UO Green.

B. Space hoop racks 30 inches apart on base plate/rail. Refer to Drawings.

2.3 LITTER RECEPTACLES

A. UO Campus Standard.

2.4 TRENCH DRAIN GRATES

A. Decorative trench drain at plaza: Jamison Ductile Iron Grate by Urban Accessories, or approved.

1. Size: 12 inches wide x 48 inches long.

2.5 AREA DRAIN GRATE

A. Area drain grate: 12 inch square OPCB Ductile Iron drain cover by Urban Accessories, or approved.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive bicycle racks.

B. If substrate preparation is the responsibility of another installer, notify Owner's Representative of unsatisfactory preparation before proceeding.

C. Do not begin installation until unsatisfactory substrates have been properly repaired.

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 site furnishings level, plumb, square, and correctly located as indicated on the 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 Substantial Completion.

END OF SECTION

MACHINE ROOM-LESS HYDRAULIC ELEVATORS

PART 1 GENERAL

1.1 SUMMARY

A. Elevator Contractor shall furnish, provide and install all work required to complete the new installation of one (1) elevator as stated in the Contract Documents. Project also includes all requirements of Firefighters' Service, Seismic, and The Americans with Disability Act (ADA).

B. Work Required By Others-Refer to Related Sections.

1. Provide HVAC for elevator control room. Temperature range shall be between 55 and 100 degrees F., 95% non-condensing. Size of the AC unit shall be detennined by elevator contractor's BTU output data of the controller/selector.

2. A plumb and ASME A17.1 Code approved hoistway, property framed and enclosed. Hoistway shall be vertically plumb within one (1) inch the entire vertical height.

3. An enclosed Code approved elevator control room. The control room shall be secured against unauthorized access in accordance with Code requirements.

4. Provide on the outside of the elevator control access door reading “Authorized Personnel Only-Storage or Installation of Equipment Not Pertaining to the Elevator is Prohibited". Letters shall be not less than 3/8" high. Sign shall be plastic or metal and securely fastened so as not be readily removed without the use of special tools.

5. Adequate supports and foundations are required to carry the loads of all elevator equipment.

6. Adequate supports for car guide rail brackets, not to exceed spacing required by Code.

7. Front hoistway entrance walls to be constructed after door frames and sills are installed. Entire front hoistway wall at a landing designated by elevator contractor shall be not installed until elevator equipment is installed .

8. Beams for car guide rail support. Reaction loads and location of beams to be provided by Elevator Contractor.

9. Grouting door sills, fixtures boxes and hoistway frames after installation by elevator contractor.

10. Provide hoist beam at top of hoistway as directed by Elevator Contractor. Size of beam to be provided by Elevator Contractor. Remove beam after Elevator Contractor installs equipment.

11. Provide front hoistway wall cutouts or sleeves for hall push button fixture box installation. Size and location of cutouts or sleeves shall be provided by Elevator Contractor.

12. Provide Class "ABC", 10 lb. minimum, fire extinguisher in elevator control room. Provide metal mounting bracket and locate just below the control room light switch, adjacent to lock side of access door.

13. Provide bevels on beams, (not spreader beams) floor slabs or other building construction that projects into the hoistway more than four (4) inches. Bevel shall be a minimum of 75% from the horizontal.

14. Elevator control room door shall be provided as follows:

    a. Minimum width of 3'-6" wide by 7' high and classified as a 1hour, fire rated door.

    b. Be self-closing and self-locking.

    c. Be provided with a spring-type lock arranged to permit the doors to be opened from the inside without a key.

15. Provide temporary enclosures, barricades or other protection from open hoistways and elevator work area during the time elevator is being installed.

16. Cutting of walls, floors, etc.,if required and the removal of such obstructions as may be necessary for proper installation of elevator equipment.

17. All painting, except as otherwise specified.

18. Adequate and safe storage for elevator equipment prior to and during installation.

19. Proper electric power mains, including dedicated ground conductor to the electrical main line disconnect switch. Voltage variations to be within + or - five percent (5%) of normal electrical power. Frequency variations to be within + or - two percent (2%) Hertz.

20. Provide fused and lockable, in the open position, main line electrical disconnect switch for the elevator controller. Provide required conduit and electrical wiring, including electrical ground conductor, from main line disconnect to elevator controller. Provide fuses of correct rating.

21. Provide an Electrical Shunt Trip Device if water sprinklers are installed in the Control Room.

22. Proper elevator control room lighting to provide a minimum of nineteen (19) FTC at all areas of the control room floor level and overhead machine/sheave area. Provide adequate number of four foot (41 fluorescent lighting fixtures. Provide guards on all light bulbs. Vertical clearance from elevator control room floor the underside of all lighting fixtures, including guards, shall be not less than seven feet zero inches (7'-0'). Required lighting shall not be connected to the load side terminals of the ground-fault circuit-interrupter receptacles(s). Light switch shall be located on the lock-jamb side of elevator control room access door and at the top area of the hoistway.

23. Provide separate branch circuit for the duplex receptacle-15A-120 VAC in elevator control room. Provide the GFCI protection. ocate below the elevator control room light switch.

24. Provide separate circuit/lockable disconnect switch in elevator control room for intercom.

25. Provide lockable disconnect switch box-20A-120 VAC separate electrical circuit to the elevator controller for car lighting, receptacle(s), auxiliary lighting power source and ventilation. Disconnect switch shall be located in the elevator control room and located as to not violate the elevator equipment electrical clearance requirements. Install disconnect switch location as directed by Elevator Contractor. Switch shall be marked with a metal tag of one half inch (1/2”) letters, stating "Car Lighting.” Provide and install all wiring including conduit from disconnect switch to elevator controller.

26. Provide lockable disconnect switch box-20A-120 VAC separate electrical circuit to the elevator controller for the Intercoms. Disconnect switch shall be located in the elevator control room and located as to not violate the elevator equipment electrical clearance requirements. Install disconnect switch location as directed by Elevator Contractor. Switch shall be marked with a metal tag of one half inch (1/2") letters, stating "Intercoms". Provide and install all wiring including conduit from disconnect switch to elevator controller.

27. Provide pit lighting a minimum of ten (10) FTC at all pit floor areas. Pit light switch shall be located adjacent to top•of pit ladder. Provide a minimum of two fixtures. Light bulbs shall be guarded to prevent contact and accidental breakage. Fixtures shall be located at least twenty-four inches (24") vertically from the pit floor. Required lighting shall not be connected to the load side terminals of the ground-fault circuit-interrupter receptacles(s).

28. Provide separate branch circuit duplex receptacle rated-15A-120 VAC in the elevator pit. Include the GFCI protection. ocate receptacle a minimum of twenty-four inches (24") above the pit floor.

29. Provide Smoke Detectors in elevator control room and all enclosed elevator lobbies. Smoke Detectors shall be instaDed in accordance with NFPA 72, Chapter 5-3. Smoke Detectors shall activate Elevator Recall-Phase I-Firefighters' Service. Provide four (4) separate signals from the following Smoke Detector locations:

    a. One (1) separate signal from all elevator lobbies and the elevator control room Smoke Detectors, except the Main Floor Recall Lobby Smoke Detector.

    b. One (1) separate signal from the Main Floor Recall Lobby Smoke Detector.

    c. One (1) separate signal from the control room Smoke Detector.

    d. One (1) separate signal from the top of hoistway Smoke Detector.

e. All signals shall be a normally closed electrical contact from the Smoke Detectors. All wiring in elevator hoistway and control room shall be enclosed in conduit.

f. All signals shall terminate at the elevator controller as directed by the Elevator Contractor.

30. Separate phone line to elevator controller. All wiring in elevator control room shall be enclosed in electrical conduit. Terminate phone line on side of the elevator controller in a two inch by four inch (2" x 4") electrical box with cover plate. Provide a minimum of three feet (3') of phone line in box for Elevator Contractor's use. Phone line shall be provided by Owner.

31. Provide a minimum of ten (10) FTC at each elevator lobby. Measurement shall be taken at each hoistway door landing sill area .

32. Provide elevator dry pit sump. Provide a sump or drain that can remove 3000 gallons of water per hour. If a sump is selected then it must be provided with a separate pit dedicated electrical circuit.

33. Provide hoistway venting or pressurization as required by the IBC.

34. Provide a 1-inch EMT from the elevator controller to the Fire Command Center, if required.

C. Applicable Documents:

1. Americans with Disabilities Act Accessibility Guidelines (ADAAG), and the equivalent State of Oregon Codes, whichever are more stringent.

2. State of Oregon Regulations, including:

a. Safety Code for Elevators and Escalators ASME A 17.1-Current edition.

b. Inspectors Manual for Electric Elevators, ASME A17.2.1.

c. National Electrical Code, No. ANSl/NFPA 70-latest version.

d. Within this section, these are referred to collectively as the Elevator Safety Code. Any reference herein to the Elevator Safety Code includes the applicable provisions of any and all of these above stated documents.

D. Permits and Codes:

1. All equipment and new installation work shall comply with requirements of the Elevator Safety Code, and other applicable codes of the State of Oregon.

2. Give necessary notices, obtain licenses and permits, and pay fees and other costs, including making arrangements for all inspections and tests required by regulating agencies.

3. File necessary plans, prepare documents, and obtain necessary approval of governmental departments having jurisdiction and required certificates of inspection for the Work, and deliver it to the Elevator Consultant before requesting acceptance and final payment for work.

4. Elevator Contractor is not relieved from furnishing and installing work shown or specified which may be beyond requirements of ordinances, laws, regulations and codes.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A6, General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use.

2. ASTM A36, Structural Steel.

3. ASTM A108, Steel Bars, Carbon, Cold-Finished, Standard Quality.

4. ASTM A167, Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

5. ASTM A366, Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.

6. ASTM A569, Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality.

7. ASTM B209, Aluminum-Alloy Sheet and Plate.

8. ASTM B221, Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

B. ANSI A117.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.

C. ADAAG, Americans with Disabilities Act Accessibility Guidelines.

D. ANSI/NFPA 70, National Electrical Code.

E. ANSI/NFPA 80, Fire Doors and Windows.

F. ASME/ANSI A17.1, Safety Code for Elevators and Escalators.

G. ANSI/UL 10B, Fire Tests of Door Assemblies.

1.3 NEW CONSTRUCTION ITEMS

A. Elevator Contractor shall verify exact distances between points shown on their Shop Drawings by actual measurements at the site.

B. Standard Products: Unless otherwise indicated, the equipment to be furnished under these Specifications shall be the standard products of manufacturers regular1y engaged in the production of such equipment. Apparatus, equipment and systems furnished must be similar and equal thereto with respect to quality, functional performance, capacity and efficiency.

C. Only that equipment and software which is nonproprietary and is available for general sale or lease, demonstrable, operation at customer sites (other than vendor or test sites) prior to the bid response date, and is new (unused) and in production on the response date, and is backed by guarantees that replacement parts and all software upgrades/updates will be available for the life of the equipment from the date of purchase will be acceptable as meeting minimum system requirements.

D. Equipment provided must be of a design to allow maintenance to be performed by a qualified elevator service contractor employing journeyman elevator mechanics. Information and equipment shall be provided to the Owner including diagnostic tools, diagrams, and instructions for maintenance, operational logic, troubleshooting, programming, and corrective procedures. The information and equipment mentioned above shall include details of all electromechanical and solid state components, features, and devices.

1. The above information and equipment shall be the property of the Owner. The Owner certifies he or his agents will not sell or reproduce said information or equipment. Bids including proprietary equipment shall be considered nonresponsive.

E. All items that require special tools and/or test equipment must be brought to the attention of the pertinent Owner’s Campus Operations personnel prior to specification and/or installation.

F. Training is to be provided to Campus Operations Elevator Maintenance personnel to a technician and service level.

G. Submittals: Submit Shop Drawings for approval. They shall contain enough detailed information to determine that the equipment conforms to the requirements of this Specification and not less than the following information: Refer to Division 1 Section “Submittal Procedures” for submitting Procedures.

1. Elevator diagrams showing service to each level.

2. Show location of machinery and controls in control rooms, layout of the hoistway in plan and elevation and all other layout information and clearance dimensions required by the Elevator Safety Code. The elevator equipment is to be arranged in a neat and workman-like manner so that all elevator equipment is readily accessible. Submit layout drawings as required by the Authority Having Jurisdiction (AHJ). Submittals to the AHJ shall have all information pertinent to the new installation to determine whether the new installation complies with all applicable Codes.

3. Provide Shop Drawings and catalog cuts for all Elevator Contractor furnished materialand equipment, including but not limited to doors, car enclosure, car and hall fixtures, controls and motors. Hoist motor data shall include temperature rise ratings in a form that can readily be measured in the field after new installation.

4. Complete information on motor, electrical services, controls, and all other coordination information.

H. Wiring Diagrams: Provide complete "As Built and Installed" single-line wiring diagrams showing the electrical connections, functions, and sequence of operation of all apparatus connected with the elevator, in the control room, hoistway and car. Provide three (3) sets laminated and bound into a three (3) ring binder, measuring twelve inches (12") by eighteen inches (18"). Furnish one complete draft set for Architect review not later than one (1) week before issue of the permanent State of Oregon Elevator Operating Permit.

I. New Installation Data: Provide "As Built and Installed" wireman's original pull sheets showing raceway, junction box, traveling cable wire nomenclature and origination and termination locations. Provide a legible copy of the elevator adjuster's final control settings, such as feet per minute, door open, door close, car door nudging time, door dwell times and all other adjustable features and/or timers.

1. Operations and Maintenance Manuals:

a. Furnish three (3) complete operation and maintenance manuals covering the stipulated mechanical/electrical systems and equipment. Furnish one (1) complete draft manual for Architect and Elevator Consultant review not later than one (1) week before issue of the permanent State of Oregon Elevator Operating Permit.

b. The manual shall be complete in all respects for all equipment furnished and installed, controls, accessories and appurtenances stipulated. Include as a minimum the following:

(1) Drawing or diagram showing equipment location.

(2) The original factory Adjustor's Manual used to adjust the specific new installation including "As Built, As Installed and As Adjusted" field notes.

(3) Step-by-step procedure for elevator start-up, operation and shutdown.

(4) Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides for all elevator equipment.

(5) Preventive Maintenance schedule.

(6) Lubrication schedule including type, grade, temperature, range and frequency.

(7) Safety precautions, including diagrams and illustrations as needed for clarity.

(8) All testing procedures, including no-toad, full-load safety tests, Seismic and Firefighters' Service.

(9) Parts lists, with manufacturers' names and catalog numbers. Lists shall be complete for the materials installed.

(10) Serial number of all equipment furnished and installed.

(11) Service organizations and sources of replacement parts with Company names, addresses, fax, e-mail and telephone numbers.

(12) Provide all service and field technical bulletins or manuals normally supplied to the factory/field Adjuster including videotapes or other media.

1.4 MATERIAL AND EQUIPMENT

A. General: Material and equipment shall be new, of the best quality used for the purposes in good commercial practice, the best of their respective kinds, and as specified. Equipment shall be standard products of reputable manufacturers. Where two or more units of the same class of equipment are required, those units shall be products of a single manufacturer. Furnish equipment complete with all parts necessary for proper operation. Material and equipment shall be cleaned, free of corrosion, and selected to provide quiet operation.

B. Type capacity, size and rating of all equipment shall be as indicated on the Drawings, and/or herein specified.

C. Delivery and Storage: Material and equipment shall be suitably protected against corrosion, dirt, mechanical damage, weather and chemical damage before and during new installation as recommended by the manufacturer and as approved by the Architect. Replace defective and damaged equipment and materials. Elevator Contractor shall pay for all cost of material storage, either on-site or off-site.

1.5 WELDING

A. All welding shall comply with ASME A17. 1-Design for welding, repair, cutting or splicing of members upon which the support of the car, counterweight, shall be prepared by a licensed professional engineer.

B. Welding shall be by welders qualified in accordance with the requirements of Section 5 of ANSl/AWS 01.1.

C. At the option of the Elevator Contractor, the welders may be qualified by one of the following:

1. The manufacturer.

2. A professional consulting engineer.

3. A recognized testing laboratory .

D. Elevator Contractor shall furnish all required documentation to the Archuitect before starting the elevator new installation.

1.6 ELECTRICAL

A. Provide electrical components of the elevator equipment and systems, including motors, motor starters, controllers, control instruments, switches, conduit, wire and relays as specified herein and as necessary for complete and operable systems. Furnish interconnecting wiring for components of equipment as an integral part of the equipment.

B. Provide NEMA 1-electrical equipment cabinets and electrical conduit and junction boxes in control room, hoistway and car.

C. Electrical equipment and wiring shall conform to applicable paragraphs of the Elevator Specifications and National Electrical Code.

D. For equipment with electrical components, provide UL label on each component for which published standards exist.

E. The frames of all motors, machines, controllers, transformers and the metal enclosures for all electrical equipment in or on the car, hoistway and control room shall be grounded in accordance with NEC-Article 250. Provide "daisy chain" electrical grounding for all control room electrical cabinets.

F. Provide required and adequate electrical wiring gauge sizing and number of electrical conductors to totally eliminate any voltage/amperage drop/variation for all the control room, hoistway switches/interlocks, car operating fixtures/positions indicators/exhaust fan/car lighting/inspection stationneveling devices, hall stations/position indicators and all other elevator electrical equipment.

G. Conductors and Connections: Provide wiring in control room, hoistway and car. Copper throughout with individual wires coded and connections on identified studs or terminal blocks. Use no splices or similar connections in wiring except at terminal blocks, control cabinets, junction boxes. Provide 10% spare wires in all wiring runs. Separate and mark all spare wires. All spare wire ends shall be turned back or protected against accidental exposure to any live electrical circuit or electrical ground.

H. Conduit and Duct: Provide painted or galvanized steel conduit and duct. Conduit size, one half inch (1/2") minimum. Do not use flexible conduit exceeding thirty six inches (36") in length. Flexible heavy-duty service cord may be used between fixed car wiring and car door switches for door protection devices. Plastic wire ties shall not be allowed for conduit fastenings or support except flexible electrical cords to the car door detector control box.

I. Traveling Cables: Provide flame and moisture-resistant outer cover. Prevent traveling cables from rubbing or chafing against hoistway or elevator equipment within hoistway. Provide ten

percent (10%) spare conductors in each traveling cable. Provide an extra four (4) spare pair of shielded wires with two (2) number 22 AWG Coax cables in a separate traveling cable. Provide an extra two (2) pair of #14 conductors for car lighting. All spare wire ends shall be turned back or protected against accidental exposure to any live electrical circuit or electrical ground. Tag all spare conductors indicating termination points at each end. Provide all wiring for car lighting, fan and ADA emergency communication from elevator controller to car. Provide all required traveling cables for the in-car Card Readers: Terminate traveling cable ends in main car perating station and the other end in controller. Provide all traveling cables for in-car Fireman's phone jack.

J. Firefighter's Service Smoke Detectors: Elevator Contractor shall furnish all labor and material to electrically wire-in the Smoke Detectors to the elevator controller from terminals supplied in the elevator control room from all Smoke Detectors.

1.7 PAINTING

A. All exposed metal work furnished in these specifications, except as otherwise specified, shall be properly painted after new installation.

B. Paint machine, controller and other control room equipment with one coat of light gray enamel.

C. Paint control room floor with one coat of dark gray enamel.

1.8 MAINTENANCE CONTROL PROGRAM (MCP)

A. Provide an MCP for the elevator equipment. The MCP shall include, but is not limited to the following:

1. Examinations, maintenance, and tests of equipment at scheduled intervals in order to ensure that the installation conforms to the requirements of ASME A 17.1/CSA 844 Section 8.6. The maintenance procedures and intervals shall be based on:

a. Equipment age, condition, and accumulated wear.

b. Design and Inherent quality of the equipment.

c. Usage.

d. Environmental conditions.

e. Improved technology.

f. The manufacturer's recommendations for any SIL rated devices or circuits.

2. Cleaning, lubricating, and adjusting applicable components at regular intervals and repairing or replacing all worn or defective components where necessary to maintain the installation in compliance with the requirements of ASME A17.1/CSA 844/ Section 8.6.

3. The instructions for locating the Maintenance Control Program shall be provided in or on the controller along with instructions on how to report any corrective action that might be necessary to the Owner.

4. The maintenance records required shall be kept at a central location agreeable and accessible to the Owner and the Elevator Contractor's elevator personnel.

5. The Maintenance Control Program shall be accessible to the elevator personnel and shall document compliance with ASME A17.1/CSA 844 Section 8.6.

6. Procedures for tests, periodic inspections, maintenance, replacements, adjustments, and repairs for all SIL rated E/E/PES electrical protective devices and circuits shall be incorporated into and made part of the Maintenance Control Program.

7. Where unique or product-specific procedures or methods are required to inspect or test equipment, such procedures or methods shall be included in the Maintenance Control Program.

1.9 WARRANTY PREVENTIVE MAINTENANCE

A. Elevator Contractor shall perform Full Service Maintenance (hereinafter referred to as the "Services" and/or the "Work") on the Elevator/s (the "equipment") specified herein which shall include preventive maintenance services. All equipment under this Warranty Period shall be maintained in first-class operating condition. Elevator Contractor shall furnish all materials and labor, and comply with all requirements of current elevator Codes. Elevator Contractor shall place into operation a continuing system of Full Preventive Maintenance to provide necessary systematic services and preventive maintenance for the Elevator equipment described herein.

B. All elevator service, repair and maintenance shall be conducted in a manner consistent with The University of Oregon' intent to provide uninterrupted service. All specified elevator/s must provide reliable and safe transportation for The University of Oregon's staff, visitors, equipment and materials on a continuous basis, 24 hours a day, 7 days a week.

1. Elevator Contractor agrees to accept full responsibility for the equipment, as it exists on the effective date of this Warranty Period, and to leave it in a condition acceptable to The University of Oregon at the termination date.

2. Neither The University of Oregon nor Elevator Contractor may assign this Warranty Period without the written consent of the other party.

3. No covenant or condition of the Warranty Period may be waived, except by the written consent of the other party. Forbearance or indulgence by either party in any regard whatsoever shall not constitute a waiver of a covenant or condition to be performed by the other party.

4. Any written notification required to be provided pursuant to the terms of this Warranty Period shall be by means of hand delivery, overnight US Mail or private carrier, or by postage prepaid, certified mail, with a return receipt required. The notice shall be effective upon the date of transmission by the sending party.

5. Any amendment to this Warranty Period shall be in writing and signed by each duly authorized representative(s) for each respective organization executing this Warranty Period.

C. PROTOCOL COMPLIANCE

1. Elevator Contractor shall insure that any and all protocols regarding the provision of Warranty Period services established by The University of Oregon shall be specifically followed. Elevator Contractor shall work with The University of Oregon Facilities Management and any authorized firm contracted to The University of Oregon, to insure proper compliance with said protocols.

D. SERVICE QUALITY VALIDATION

1. Insofar as the services provided by the Elevator Contractor fails to comply with required standards or has not been provided as per The University of Oregon' established protocols, The University of Oregon shall not be obligated to reimburse Elevator Contractor for any such service until such deficiencies have been corrected by Elevator Contractor and successful re-inspection by The University of Oregon or Architect is completed.

E. WARRANTY PERIOD ADMINISTRATION

1. Notwithstanding any other provisions of this Warranty Period or any document referenced herein, The University of Oregon, or other authorized representative, shall be the only individuals authorized to make changes in or redirect the work required by this Warranty Period. Where The University of Oregon's approval is required under the terms of this Warranty Period, it shall be construed to mean the approval of The University of Oregon or other authorized representative. In the event Elevator Contractor effects any change at the direction of any other individual, the change shall be considered as having been made without authority and an adjustment shall not be made to the Warranty Period price or performance requirements as a result thereof.

F. INTENT AND ACCEPTANCE

1. Elevator Contractor acknowledges The University of Oregon has provided free access to and sufficient time for adequate examination of the equipment and review of service records. Elevator Contractor further acknowledges that the specified elevators/s listed have been inspected by Elevator Contractor and that Elevator Contractor has determined that they are in serviceable operating condition. Elevator Contractor accepts full and complete responsibility for Full Service Maintenance and Repair of the specified elevators/s listed, as is condition, in accordance with this Warranty Period.

G. DEFINITIONS

1. Preventive Maintenance: Those services required by Elevator Contractor to provide Preventive Maintenance as defined in this Warranty Period, to prevent malfunctions/shutdowns due to normal wear and tear, to provide for safe operating elevators and to prolong the life of all elevator equipment.

2. Cleanliness: The Elevator Contractor is required to maintain the entire elevator system in a clean manner at all times. This includes but is not limited to: removal of oily rags-removal of dirt, grease, lint-maintaining the exterior of all equipment free of lint, dirt, oil, grease- clean all machine/control room equipment including, floors, controller/selector, governor, hoist machine, brake, sheave, hoist motor interior, deflector sheave, machine beams, car top, hoistway door track, hanger, interlock, header, strut, hoistway side of sills, spreader beam, buffer, underside of car platform, car guide, car safety, car door operator, track, hanger, inside area of header, crosshead, guide rail/bracket. fascia, dust cover, pit, inside car station/hall station/lantern/lobby panel and

3. all equipment. The cleaning must be a minimum of Elevator Industry Standards of which is stated above, and shall be to the full satisfaction of The University of Oregon. If The University of Oregon decides the cleaning level is below The University of Oregon's Standards, The University of Oregon has the option of bringing in another Elevator Contractor to perform the cleaning (with notice provided per Section 1.15, 1 of the Warranty Period). All costs of the cleaning by another Elevator Contractors plus the cost of supervision by The University of Oregon shall be paid by the Elevator Contractor that is performing the Preventive Maintenance under this Warranty Period.

4. Obsolescence: Obsolescence is defined as a replacement part not being available for purchase by the Elevator Contractor. Elevator Contractor shall provide written documentation the replacement part is not available and the Elevator Contractor has exhausted all research in obtaining such replacement parts. Such research would be the review of all firms as listed in the latest edition of Elevator World-"The Source". All local supply firms, including other Elevator Contractors must also be researched for availability of replacement parts. If the replacement part is not available, The University of Oregon shall pay the cost for such replacement part as the difference in cost of the new part as compared to the existing part at time of last purchase. Elevator Contractor shall provide all documentation of the replacement costs. All labor to install the new replacement part is included in the Warranty Period. The new replacement part, after being installed, shall be included in this Warranty Period and further replacement is included in this Warranty Period at no extra cost to The University of Oregon. If Elevator Contractor installs a replacement part different than the original equipment, the new replacement shall not be of the •proprietary" type and the Elevator Contractor shall provide, in writing, the manufacture, type and model of the proposed replacements part.

H. GENERAL CONDITIONS

1. All maintenance performed by Elevator Contractor shall be based upon the performance specifications of individual equipment as published by the equipment manufacturer or as otherwise indicated herein.

2. Elevator Contractor shall comply with approved Elevator Equipment Industry Safety Standards. Elevator Contractor shall provide a copy of their Safety Program to Elevator Consultant and The University of Oregon Elevator Coordinator within five (5) calendar days after award of Warranty Period.

3. In performance of this Warranty Period, Elevator Contractor agrees to carry out all Work in strict compliance with all laws, Codes, rules and regulations set forth with regard to the equipment by Municipal, State and Federal authorities having jurisdiction in effect on the Warranty Period commencement date over the Work or any part thereof.

4. Elevator Contractor shall provide The University of Oregon Elevator Coordinator, within five (5) calendar days the starting of this Warranty Period, with Material Safety Data Sheets for products Elevator Contractor intends to employ under this Warranty Period prior to commencement of work. It shall remain the responsibility of Elevator Contractor to inform and train Elevator Contractor's employees on the use of the MSOS requirements. All MSDS documents shall be sent to The University of Oregon. Failure to furnish any such documentation, within the time schedule, shall be construed as terms by which to immediately terminate this Warranty Period.

5. Elevator Contractor shall protect all building equipment, surfaces, etc. from damage and shall perform repairs/replacement of any damaged items to "as new" condition thereto at their own expense to the entire satisfaction of The University of Oregon. Elevator Contractor agrees to accept responsibility for all damage to equipment due to neglect of their personnel in the maintenance of equipment identified in this Warranty Period. Elevator Contractor agrees that all labor furnished by Elevator Contractor shall be trained journeyman level mechanics and helpers, thoroughly skilled in elevator Preventive Maintenance and directly employed and supervised by Elevator Contractor. They will use all reasonable care to maintain the equipment in a proper and safe operating condition at all times. Elevator Contractor shall enforce strict discipline and order among their employees while on The University of Oregon' premises, and shall be subject to the rules and regulations established by The University of Oregon. The University of Oregon Elevator Coordinator reserves the right to request Elevator Contractor to replace any or all employees assigned to its facilities if it deems they are not performing in a satisfactory manner, or who refuse to comply with The University of Oregon' policies and guidelines.

6. Elevator Contractor's field personnel shall wear clean, neat, well-maintained uniforms identifying them as employees of Elevator Contractor for ease of identification by The University of Oregon.

7. Elevator Contractor shall provide The University of Oregon with the names of Service Technicians that will be assigned to the Warranty Period within five (5) business days after award of Warranty Period. List shall be up-graded to current each time Service Technician change routes or assignments.

8. Elevator Contractor shall provide a back-up personnel list within five (5) business days after award of Warranty Period for each of their employees assigned to The University of Oregon' account in the event of their illness, disability, vacation, leave, or absence for any reason. Said back-up personnel are expected to cover all duties and responsibilities of Elevator Contractor's regular personnel with no disruption in service. The University of Oregon and Elevator Consultant shall be informed prior to back-up personnel being used.

9. Elevator Contractor shall be required to provide a member of their supervisory personnel, regularly engaged in inspection and supervision, to visit the elevator at least quarterly to observe the quality of maintenance and to make certain that the quality of maintenance meets the specified and intended standards. The Supervisor shall schedule each visit with The University of Oregon Elevator Coordinator. The University of Oregon shall provide a member of their staff to accompany the Elevator Contractor during the on-site inspection. Inspections by the Elevator Contractor shall be at no cost to The University of Oregon.

10. Contact shall be made with The University of Oregon Elevator Coordinator upon Elevator Contractor's arrival and upon completion of service or any time Elevator Contractor's personnel leaves the site. Elevator Contractor shall check out a key from the UOPD for access to facilities/buildings/machine/control rooms. This key may be removed from the premises. The key(s) shall be returned to the University of Oregon upon the expiration of the twelve (12) month Warranty Period. If the Elevator Contractor loses the keys, the Elevator Contractor shall pay for all cost of duplicate or rekeying and new locks.

11. Elevator Contractor shall be solely responsible for:

    a. All means, methods, techniques, sequences, and procedures of the Work at no extra cost to The University of Oregon.

    b. Keeping all 'Work Areas" clean and using all available means to recycle or reclaim materials.

12. Elevator Contractor shall provide a written procedure of their “Lock Out-Tag Out" to The University of Oregon within five (5) calendar days of Warranty Period award and before starting work under this Warranty Period.

I. SERVICE REQUIREMENTS

1. Complete Maintenance: Elevator Contractor agrees to regularly and systematically examine, clean, lubricate, adjust and provide unlimited callback service and repair and replace all components of the elevators included under these specifications in accordance with industry standards in a proper Workmanlike manner to the entire satisfaction of The University of Oregon.

2. Elevator Contractor shall repair cab handrails and maintain fastening bolt tightness, repair and maintain communication equipment installed by Elevator Contractor and communication equipment cabinetry doors and door hinges.

3. Elevator Contractor shall include the following elements in the Preventive Maintenance Procedures for all elevators:

    a. Provide monthly operational checks of all elevator car door safety edges/detectors at University of Oregon. Elevator Contractor shall provide documentation of such checking in their machine/control room check charts.

b. Provide monthly check of directional lights; call registered lights and all other elevator lighting fixtures. Furnish and replace all burned out bulbs.

c. Maintain pit lighting, car top lighting, hoistway lighting and car interior lighting. Furnish and replace all bulbs.

4. Elevator Contractor shall notify The University of Oregon Elevator Coordinator before an elevator is removed from service. Elevator Contractor shall notify The University of Oregon Elevator Coordinator when such elevator is placed back in normal service. The schedule for provision of service by Elevator Contractor shall vary according to the frequency as stated in this Warranty Period. Elevator Contractor is expected to work closely with The University of Oregon and/or any firm authorized by The University of Oregon to arrange specific service times that are most beneficial to The University of Oregon.

5. Elevator Contractor shall maintain hoistway, pit, machinery, elevator machine/control room, and any assigned Elevator Contractor's Work space in a clean, orderly condition, free of dirt, dust, oil and grease spills, trash and debris, at all times.

6. Elevator Contractor shall be sensitive to The University of Oregon's needs during their Work activity and create no excessive noise. Work that will generate excessive noise shall be scheduled with The University of Oregon Elevator Coordinator.

7. Elevator Contractor shall maintain three (3) complete sets of wiring diagrams showing "as built" conditions with any changes or modifications to circuits resulting from control modifications, parts replacement or equipment up-grade. One set shall remain in the machine/control room, one set shall be maintained in the Elevator Contractor's office and the third set shall be maintained in The University of Oregon Elevator Coordinator offices. When any changes are made to diagrams, three copies of the modified drawings must be made. One oopy shall be furnished to The University of Oregon to update their copy of the appropriate drawing. A copy shall be used to update the Elevator Contractor's office drawings and the original changes shall be maintained in the equipment machine/control room. The University of Oregon retains sole possession of these wiring diagrams. Wiring diagrams shall be kept in a neat and orderly fashion in the machine/control room. Provide University of Oregon with one (1) digital copy on a thumb drive.

8. Elevator Contractor shall be responsible for maintaining exterior of the machinery, machine/control room floor and other parts of the elevator equipment, properly painted, identified, and presentable at all times. If, in the option of the University of Oregon, there is a need to re-paint the elevator equipment/floor, the Elevator Contractor shall proceed within five (5) calendar days to provide the work. If the Elevator Contractor does not comply with the painting requirements the University of Oregon may elect to hire an outside Contractor to perform the work and back-charge the Elevator Contractor for all costs incurred.

9. Elevator Contractor shall provide one (1) lockable metal parts cabinets in each elevator machine/control room. Elevator Contractor shall coordinate installation with The

University of Oregon Elevator Coordinator. Estimated size of 42" high-36" wide 18" deep with a lockable door. Provide one (1) key to The University of Oregon.

10. Elevator Contractor shall conduct monthly evaluations of equipment performance, including car speed, door operations, riding quality and car leveling. Following such evaluations, the Elevator Contractor shall perform adjustment, repairs and replacements required to maintain manufacturer's operating performance. A copy of evaluations will be left with The University of Oregon Elevator Coordinator and Elevator Consultant and reviewed with them on request.

11. Elevator Contractor shall, as required, but at least during the 11 month, dismantle the brake plunger assembly, examine, replace worn parts, clean, lubricate, reassemble and adjust as required for proper operation.

12. Elevator Contractor shall provide a qualified management representative to serve as Project Manager. Project Manager shall meet with The University of Oregon at such times as may be requested to discuss job details and concerns and/or any other matters concerning this Warranty Period, or the Work to be performed herein, to assure amicable and successful execution of this Warranty Period. The Project Manager shall be authorized to render any reasonable decisions to The University of Oregon without unnecessary delay.

13. Elevator Contractor shall maintain at all times the original elevator speed in feet per minute. Perform all adjustments required to maintain the proper door opening and closing time, within limits of applicable codes. Check the operating system for each unit and group of units to ensure that unit(s) keep operating continuously and make necessary tests and corrections to ensure all circuits are correct and time settings are properly adjusted.

14. Elevator Contractor shall maintain the following minimum elevator performance requirements.

    a. Speed: +/- 1% in both directions under all loading conditions for gearless/geared equipment..

    b. Door closing time: Measured from start of door closing until the hoistway doors are fully closed, will be the minimum permitted by Code.

    c. Door dwell time: As permitted by The Americans with Disability Act, as now or hereafter amended.

    d. Floor leveling accuracy: As stated in the Elevator Specifications.

15. In accomplishing the above requirements, Elevator Contractor shall maintain a comfortable elevator ride with smooth acceleration, retardation and a soft stop. Door operation shall be quiet and positive with smooth checking at the extremes of travel.

16. Any additional work required to be performed pursuant to Federal,State or Local Code amendments subsequent to the date of this Agreement, or tests required to be performed

which are not currently within the scope of this Agreement, will be performed by Elevator Contractor only upon receipt of a written change order from The University of Oregon.

17. All records and documents pertaining to the elevators equipment provided to Elevator Contractor by The University of Oregon shall be kept current and in good condition and shall be returned to The University of Oregon upon demand or upon termination of this Warranty Period.

J. TESTING

1. Elevator Contractor shall conduct the following tests, and any other tests required by State of Oregon, State of Oregon, Federal and any other Governing or Code Agency that is in effect at the date of signing this Warranty Period. Services shall include, but not be limited to:

   a. Elevator Contractor shall provide quarterly inspections and testing of the Firefighter's Service-Phase I and Phase II and standby power operation, if installed. Any additional cost to complete the above inspections and testing on overtime shall be the responsibility of Elevator Contractor. Elevator Contractor shall maintain an up-to-date log of Firefighter's Service testing in each machine/control room and submit the results to The University of Oregon Elevator Coordinator on a quarterly basis. Firefighter's Service testing shall be entered and recorded on a form supplied by Elevator Contractor and/or required by the State of Oregon, or both.

   b. Provide all testing as required by the State of Oregon Elevator Inspector and required by the ASME A17.1 Safety Code for Elevators and Escalators. Tests shall include yearly no load testing of all traction elevators.

   c. Elevator Contractor shall assist The University of Oregon during emergency generator testing. Testing shall be completed on "off' hours. Elevator Contractor shall absorb all labor costs incurred by Elevator Contractor at no additional cost to The University of Oregon. Testing to be scheduled with University of Oregon Elevator Coordinator.

2. Elevator Contractor shall on the 11th month check the dispatching systems and make necessary tests and adjustments to insure that all circuits and time settings are properly adjusted, and all systems are performing as designed and installed. Elevator Contractor shall submit an 11th month written report of these results to The University of Oregon Elevator Coordinator.

3. Elevator Contractor shall audit the elevator equipment on the eleventh (11th) month of the Warranty Period. A written report from the 11th month audit shall be provided to The University of Oregon by the last business day of the eleventh (11th) month of the twelve (12th) month Warranty Period. The written report shall include recommendations for improvements and estimates of cost for labor and materials to complete the suggested improvements. The University of Oregon' equipment will be audited for:

a. Code Compliance. Evaluate current Code compliance of all equipment. Monitor industry and Code developments and provide The University of Oregon with warning of anticipated Code changes to take effect during the fiscal year following the audit report. Recommend corrections, which should be made in the fiscal year following the audit report.

b. Equipment Performance. Audit performance of all equipment against its original parameters or specifications. Recommend corrections, which should be made in the fiscal year following the audit report.

c. Equipment Aesthetics. Audit the physical condition and appearance of the equipment visible to users and recommend upgrades, which should be considered to keep the equipment appealing to users and current with Site standards for colors and decoration schemes.

d. Written reports of said tests shall be submitted to The University of Oregon Elevator Coordinator within five (5) calendar days of actual testing.

e. The University of Oregon Elevator Coordinator shall receive seven (7) days prior written notification of all tests so that a Representative of The University of Oregon may witness said tests. Safety precautions are understood to be of highest priority. Care will be taken to safeguard all surrounding building property during the testing. If during the testing, the actual testing fails the prescribed testing procedures in the ASME A17. 1 and re-testing is required, the Elevator Contractor shall pay all costs of The University of Oregon's Representative to witness such testing.

K. CHARTS-LOGS-INSPECTIONS

1. Elevator Contractor shall post the Elevator Contractor's Maintenance Control Program (MCP) and a Work Log in each elevator machine/control room and designated area. The MCP/Work Log shall include all entries for routine and non-routine maintenance and repairs, including supervisor's surveys. Entries shall include date Work is complete, mechanics or supervisor's name, brief description of Work completed (including elevator number serviced) and the approximate time required for the Work. The MCP/Work Log and Preventive Maintenance Schedule/Chart shall be maintained for The University of Oregon' inspection at any time. The University of Oregon may copy the MCP/Work Log and Preventive Maintenance Schedule/Chart at any time.

2. Elevator Contractor shall provide The University of Oregon with a schedule, in either written or electronic form, (as preferred by The University of Oregon) of when each elevator shall be taken out of service for Preventive Maintenance. The University of Oregon must approve any changes to this schedule in writing, and may reject any schedule that conflicts with The University of Oregon' efficient operations.

3. Elevator Contractor shall offer inspections of hoistway, pit equipment, car top, machine/control room and cab interiors to The University of Oregon upon completing Preventive Maintenance scheduled at no expense to The University of Oregon.

L. DISPOSAL OF OILS/MATERIALS, ETC

1. Elevator Contractor will be fully responsible for removal and disposal of all oils, greases, solvents and soiled cleaning cloths/rags that are used in the repair, service and adjusting of all elevator equipment. All material will be disposed of in accordance with all present or future City, State and Federal Laws and Regulations, which may be applicable.

2. When work is performed, the Elevator Contractor shall insure that all areas are clean and salvaged materials or scraps are removed before leaving jobsite. If Elevator Contractor fails to do so, The University of Oregon may perform necessary clean up actions and shall invoice the Elevator Contractor for all costs.

M. EXTENT OF COVERAGE

1. Elevator Contractor shall prepare and submit to The University of Oregon a detailed preventive maintenance schedule for all elevator equipment to be serviced within five (5) calendar days after execution of the Warranty Period. As a minimum, the elevators shall be examined and maintained in accordance with the following frequency:

   a. Minimum Service Frequency : Monthly Service.

2. Extent of Coverage-Hydraulic Elevator Contractor shall:

   a. Regularly and systematically examine, clean, lubricate, adjust, and, when conditions warrant, repair or replace the following items including all other items or components pertaining to the operation, maintenance, adjusting, repair,

   b. Controllers, Starters, and Relay Panels.

   c. All Bearings.

   d. Contacts, Relays and Timers.

   e. Solid-State Devices.

   f. In-Car Emergency Lighting and all in-car lighting fixtures/bulbs.

   g. Traveling Cables.

   h. Firefighter's Service equipment.

   i. Automatic Power Door Operators, Landing and Car Door Hangers, Landing and Car Door Contacts, Door Protective Devices, Hoistway Door lnter1ocks, Bottom Door Guides.

   j. lnter1ocks and Door Closures.

   k. Car Buffers.

l. Car Exhaust Fan.

m. Car-Top Inspection Station.

n. Limit and Slowdown Switches.

o. Door Protective Devices and Alarm Bells.

p. Car and Corridor Operating Pushbuttons.

q. All Hall Lanterns, Car Position and Hall Position Indicators, Lobby Control Panels, Car Operating Panels, and all other signal and Accessory Facilities furnished and installed as a part of the whole equipment.

r. Car roller guides.

3. Furnish lubricants and all cleaning supplies.

N. EXCLUSIONS

1. The following items of equipment, hoistway and machine/control room enclosure are not included in this Warranty Period unless damaged by the Elevator Contractor.

a. Elevator Contractor shall not be responsible for the following items and shall receive compensation for repairing such items. Rates as specified in the Warranty Period:

(1) Door knocked off the tracks/broken gibs.

(2) Elevators left on independent, fire, attendant or emergency service.

(3) Elevator call buttons broken, burned or jammed.

(4) Car door detector out of adjustment from doors being hit.

(5) Elevator turned off inside the car and the door pulled shut. unless there is an actual elevator problem that is included in their Warranty Period.

b. Elevator Contractor shall not be responsible for repairs and replacement pertaining to the car enclosure, including removable panels, door panels, car doors, suspended ceilings, handrails, car finish and flooring coverings, hoistway enclosures, hoistway entrance frames, sills and emergency telephone instruments, signal fixture faceplates, Smoke Detectors, and cleaning of car interiors, unless any components has been damaged by the Elevator Contractor. Elevator Contractor shall be responsible to maintain all elevator handrails correctly fastened to the cab walls, at all times.

c. Elevator Contractor shall not be responsible to replace electrical mainline and auxiliary disconnect switches, fuses and feeders to control panels. All above-ground electrical conduit and wiring are included in the Warranty Period.

d. Elevator Contractor shall not be responsible for repairs required because of negligence, accident or misuse of the equipment by anyone other than Elevator Contractor, their employees, subcontractors, and agents.

e. The University of Oregon agrees to maintain the elevator pit and machine/control room free from water and from unauthorized use.

f. Elevator Contractor shall not be obligated to make other safety tests or install new attachments, whether or not recommended or directed by insurance companies, or by federal,state, municipal,or other governmental or non-governmental authorities unless requested to do so by The University of Oregon. In that event, Elevator Contractor shall proceed to perform the tests or work, and shall be reimbursed at the rates as stated in the Warranty Period. Elevator Contractor shall advise The University of Oregon, however, whenever such tests or attachments are recommended or required. Elevator Contractor shall not be required to make renewals or repairs necessitated by the negligence, misuse or obsolescence of the equipment or any other cause beyond its control except ordinary wear and tear unless such renewals or repairs are caused by Elevator Contractor's negligence or misuse in performing or failure to perform pursuant to this Warranty Period.

O. INSPECTION OF EQUIPMENT AND FEES

1. The University of Oregon reserves the right to make such inspections and tests whenever necessary, at their expense, or at the expense of the Elevator Contractor if any provisions of this Warranty Period have not been adhered to by Elevator Contractor, when deemed necessary to ascertain that the requirements of these specifications are being fulfilled. The University of Oregon will promptly notify Elevator Contractor in writing of the deficiencies identified. Elevator Contractor shall resolve all deficiencies at Elevator Contractor's total expense within ten (1O) calendar days of written notification.

2. Elevator Inspection fees shall be paid by The University of Oregon. The University of Oregon shall notify Elevator Contractor, in writing, of items required to be completed, which are the responsibility of Elevator Contractor. Elevator Contractor shall correct all deficiencies immediately. Fees for re-inspection due to failure to eliminate deficiencies included in this Warranty Period and the responsibility of Elevator Contractor shall be paid by Elevator Contractor. Elevator Contractor shall submit, in writing, a Work schedule of items to be completed by Elevator Contractor within seven (7) calendar days of notification of The University of Oregon. Elevator Contractor shall notify The University of Oregon, in writing of all items corrected. The University of Oregon shall notify State of Oregon Elevator Inspector, in writing, of items completed with copy of report to Elevator Contractor.

P. CANCELLATION TERMS

1. If Elevator Contractor violates any of the provisions of this Warranty Period or fails to properly provide the services required by this Warranty Period, The University of Oregon shall advise, in writing, Elevator Contractor of specific deficiencies and shall allow ten (10) calendar days to correct these deficiencies to The University of Oregon's total satisfaction. The University of Oregon may after the ten (10) calendar day period proceed with the work by a Contractor of their choice to perform the work. Elevator Contractor agrees they shall reimburse The University of Oregon for any expense incurred therefore or The University of Oregon, at its election, may deduct the amount from any sum owed or to be owed Elevator Contractor under this Warranty Period. The University of Oregon may cancel this Warranty Period within thirty (30) days written notice to Elevator Contractor if any of the provisions of this Warranty Period are not completed by Elevator Contractor to the full satisfaction of The University of Oregon.

2. If The University of Oregon fails to pay current and properly payable monthly invoices within thirty (30) days of receipt of said invoice, Elevator Contractor may on thirty (30) days written notice, terminate this Warranty Period.

Q. REQUESTS FOR SERVICE

1. Elevator Contractor shall provide 24-hourn-days a week answering service and shall provide a list of Elevator Contractor's Management Personnel home phone numbers for emergency contact in the event the answering service is ineffective. Management list shall be submitted to The University of Oregon within five (5) working days of the Warranty Period start date.

2. Elevator Contractor shall respond to all phone messages from The University of Oregon within fifteen (15) minutes of receipt.

3. Emphasis shall be placed on maintaining the elevators/s operating 24 hours a dayn days a week. Removal of equipment from service for scheduled maintenance shall be scheduled with The University of Oregon Elevator Coordinator.

4. No repair shall be performed outside the scope of this Warranty Period without prior approval from The University of Oregon.

5. If any equipment is shut down for more than twenty four (24) continuous hours after notification of a failure (except for pre-scheduled or major equipment repairs) the monthly unit billing shall be suspended until the individual elevator equipment is restored to service.

6. In the event of an elevator failure to operate properly, The University of Oregon will notify Elevator Contractor by telephone and request immediate repair. For this purpose, Elevator Contractor shall maintain, at all times, office facilities, a twenty-four (24) hour telephone service and personnel to promptly dispatch competent mechanics to repair any reported elevator problem.

7. If a safety or potential safety problem exists, Elevator Contractor shall immediately correct the problem. Written notification of such corrective measures shall be provided to The University of Oregon, in writing, within one (1) business day.

8. In case of an elevator accident, Elevator Contractor shall be notified immediately by The University of Oregon. The elevator shall not be placed in operation untilan investigation is performed by The University of Oregon's representative and State of Oregon Elevator Inspector. Elevator Contractor shall provide a written report to The University of Oregon stating the condition of the elevator before the Elevator Contractor leaves The University of Oregon's facility. The elevator will not be placed in operation until an investigation is performed by The University of Oregon's representative and/or the State of Oregon Elevator Inspector if the following conditions occur:

    a. A person has been injured and requires first aid treatment.

    b. The elevator is not safe to place in normal operating service because of obvious mechanical and/or electrical existing conditions.

    c. There is a concern by the Elevator Contractor or The University of Oregon as to the possible future elevator malfunction if placed in service.

9. When corrective action is found to be the responsibility of the Elevator Contractor, the Elevator Contractor shall proceed immediately to make replacements, repairs, and corrections. If Elevator Contractor fails to perform the Work required by the terms of the Warranty Period in a diligent and satisfactory manner, The University of Oregon may, after five (5) calendar days written notice to Elevator Contractor, perform or cause to be performed all or part of the Work required thereunder. Elevator Contractor shall reimburse The University of Oregon for any expense incurred therefore or The University of Oregon, at its election, may deduct the amount from any sum owed or to be owed Elevator Contractor. When such Work is determined not to be the Elevator Contractor's responsibility, a written report, including a cost estimate to remedy the deficiency, signed by the Elevator Contractor, shall be delivered to The University of Oregon by 3:00 p.m. the next business day for further action by The University of Oregon. If The University of Oregon elects to have the Elevator Contractor perform these services, they will issue a separate Purchase Order Request beforehand. If a safety problem is noted, which is not within the Elevator Contractor's area of responsibility or expertise, written notice of such problem shall immediately be furnished to The University of Oregon.

10. No allowances shall be made to Elevator Contractor for extra costs as a result of difficulties encountered during any Work. All materials incorporated in the Work shall become the property of The University of Oregon upon material/parts installation.

11. Elevator Contractor will, upon request, assist The University of Oregon with written recommendations to improve service and reduce call backs Elevator Contractor shall provide the "Callback Log Form" to The University of Oregon within seven (7) calendar days after the end of the previous month. Preventive Maintenance tickets will be separated for Work completed. The intent of this summary is to minimize callbacks by keeping the Elevator Contractor and The University of Oregon aware of callback trends. Elevator Contractor shall review Preventive Maintenance duties and Callback Trends with The University of Oregon on a monthly basis. Elevator Contractor shall provide The

University of Oregon, on a weekly basis, copies of all time tickets for "all" work performed during that week, if requested by The University of Oregon.

12. Downtime notification is required according to the following schedule:

    a. Emergency Shut Down. The University of Oregon is to be notified immediately by phone, cell phone, pager or radio of emergency repairs or safety issues at time of detection. At minimum, a voice-mail message is required.

    b. Short Shut Down. The University of Oregon is to be informed in writing (fax or e-mail acceptable) three (3) days in advance when an elevator will be taken down for two (2) hours to eight (8) hours for non-emergency service/repair/upgrade.

    c. Major Shut Down. The University of Oregon is to be informed in writing (fax or e-mail acceptable) one (1) week in advance when an elevator will be taken down for more than one (1) day for non-emergency service/repair/upgrade.

13. Elevator Contractor shall immediately shut down and remove the elevator equipment from service when it appears to Elevator Contractor to be unsafe or operating in a manner which might cause injury to anyone using said elevator equipment. Elevator Contractor shall provide The University of Oregon written notice of such action immediately, stating the reason the elevator was placed out of service and corrective measures required to place the elevator in service. Written notice shall be provided by Elevator Contractor before Elevator Contractor's personnel leaves The University of Oregon.

14. Request for "Emergency Service Requests" is made when an elevator is shut down or unsafe to use. "Emergency Service Requests" shall include the following and shall require 24 hours day 7 days a week on-site service at no additional cost to The University of Oregon:

    a. Person(s) trapped in an elevator.

    b. Any other situations relating to any or all equipment listed in "Schedule of Equipment" which, in the opinion of The University of Oregon, requires immediate response and resolution by Elevator Contractor. Examples include Seismic activity requiring reset after an earthquake and other situations in which two or more elevators in a given bank are out of service at the same time.

15. "Emergency Service Requests" Response Time is counted from the end of the phone call requesting repair to when the technician arrives at University of Oregon and contacts the Elevator Coordinator or Security Office.. Elevator Contractor shall respond to all "Emergency Service Requests" in accordance with the following standards:

    a. Weekdays between 8:00 am to 5:00 pm: Within 30 minutes. If the Elevator Contractor does not arrive on-site within the 30 minute period and the UOPD calls the Fire Department to extricate a trapped elevator passenger, the Elevator

Contractor shall pay for all cost if the Fire Department is required to damage any elevator equipment in removing the trapped elevator passenger.

b. All other days/hours: Within 60 minutes. If the Elevator Contractor does not arrive on-site within the 30 minute period and the UOPD calls the Fire Department to extricate a trapped elevator passenger, the Elevator Contractor shall pay for all cost if the Fire Department is required to damage any elevator equipment in removing the trapped elevator passenger.

c. "Emergency Service Requests" shall be resolved as quickly and effectively as possible and in such a manner that the disruption of equipment service and inconvenience to users is absolutely minimized.

16. Elevator Contractor shall mobilize all necessary resources, including labor, equipment, tools, parts and materials as required to complete the work with these requirements. Elevator Contractor shall provide unlimited "Routine Service Request" for all elevators/s not designated "Critical Service and High Volume" in "Schedule of Equipment" at no additional cost to University of Oregon. "Routine Service Requests" Response Time is counted from the end of the phone call requesting repair to when the technician arrives at University of Oregon and contacts Property Management. A "Routine Service Requesr is any request not deemed by University of Oregon to require immediate response and resolution by Elevator Contractor. "Routine Service Requests" shall include the following:

a. Weekdays between 8:00 am to 5:00 pm: Within 30 minutes.

b. All other days/hours: Within 90 minutes.

c. "Routine Service Requests" shall be resolved as quickly and effectively as possible and in such a manner that the disruption of equipment service and inconvenience to users is absolutely minimized.

d. Elevator Contractor shall mobilize all necessary resources, including labor, equipment, tools, parts and materials as required to complete the work with these requirements.

17. Remote Monitoring: Any and all remote monitoring equipment shall be at the Elevator Contractor's total expense.

18. Elevator Contractor shall assign an elevator mechanic to assist with the monthly generator tests at University of Oregon, at no additional cost to University of Oregon.

R. WORK TICKETS

1. After each service/trouble call and regular1y scheduled maintenance, a legible Work ticket will be completed indicating the date of work, work performed, parts replaced, total hours on the job and the Service Technician perfonning the Work. In the case of an elevator shutdown or repair, the Work ticket will describe the cause of the elevator failure and the action taken to correct the failure. Each week, Elevator Contractor shall

provide a written callback report showing cause and correction of each week's callback(s).

2. Each week a Report shall be sent to The University of Oregon and/or their representative, a copy of all Time Tickets, Callback Logs, Extra Billing, Test Reports, Repairs Required, that includes all items as described in 1.08 R.1. Reports shall be received no later than each Tuesday of each week.

3. All Work Tickets shall be left with The University of Oregon after all visits. Preventive Maintenance tickets shall be separated for work completed. Copies of Work Tickets shall be included in any invoice other than the monthly Preventive Maintenance Warranty Period Amount Invoice.

4. Elevator Contractor shall provide, if requested by The University of Oregon and/or a company designated by The University of Oregon, quarterly, by the 10th day of the month following the quarter, copies of the three previous monthly "Check Charts". Report shall contain, but shall not be limited to, the following information:

   a. Dates and times of inspection and/or service.

   b. Names of persons performing inspection and/or service.

   c. Location and description of equipment being inspected and/or service.

   d. Condition of equipment.

   e. Inspection/service performed.

S. HOURS OF WORK

1. All Work to be performed, not included in this Warranty Period, will be authorized by The University of Oregon by written notification to Elevator Contractor prior to commencement of the Work. All vandalism work required shall not be completed/provided by the normal Elevator Contractors Service Technician on-site for performing Preventive Maintenance unless authorized by The University of Oregon. Elevator Contractor may be required to provide additional Mechanics for extra work required.

2. Maximum travel cost shall not exceed one (1.5) Mechanic hour rate.

3. All Work to be performed, not included in this Warranty Period, will be authorized by The University of Oregon by written notification to Elevator Contractor prior to commencement of the Work. The maximum hourly rates, and material markup from cost, will be as follows:

   a. Mechanic:

      (1) Straight Time: $174.00

(2) Straight Time plus 70%: $214.00

(3) Straight Time plus 100%: $228.00

b. Helper:

(1) Straight Time: $1514.00

(2) Straight Time plus 70%: $185.00

(3) Straight Time plus 100%: $196.00

c. Material Markup: 12%

4. Preventive Maintenance Hours:

a. Elevator Contractor shall provide a minimum of one (1) hour, per month/per elevator performing Preventive Maintenance.

5. The above-stated hours shall be the minimum actual "On Site" hours performing the Preventive Maintenance duties. These minimum hours do not include Callbacks, Repairs, Travel Time, Adjustments or Testing. Documentation of Preventive Maintenance hours is required for monthly payment due Elevator Contractor. For any hours less than the stated not spent, per month, on site, on Preventive Maintenance, the dollar value (per hour) will be deducted from that month's invoice. The hourly dollar value for the Preventive Maintenance Work is $300.00.

6. Elevator Contractor shall pay for all cost's, including travel time and mileage, of any callback, including 24 hours a day,7 days a week.

7. Elevator Contractor shall pay for all cost's, including travel time and mileage, of any regular time callback if the following conditions occur:

a. If the elevator is running on arrival (ROA) when Elevator Contractor arrives on-site, and it was verified by The University of Oregon that the elevator was either not in operation or in a state of not operating correctly.

T. WARRANTY PERIOD

1. The term of this Warranty Period shall be for a twelve month (12) period. Warranty Period

U. CONFIDENTIAL INFORMATION

1. Neither Elevator Contractor, nor Elevator Contractor's agents, employees, or subcontractors, shall disclose to any person or entity any of The University of Oregon's confidential information, whether written or oral,which Elevator Contractor or Elevator Contractor's agents, employees, or subcontractors may obtain from The University of

Oregon, or otherwise discover in the performance of this Warranty Period. The term "Confidential Information" shall include, without limitation;

a. The terms of this Warranty Period are confidential and, except as otherwise required by law, The University of Oregon and Elevator Contractor shall not disclose the terms or existence of this Warranty Period to any party without prior written consent.

b. All information or data concerning or related to The University of Oregon, including the improvement, development or general business operations.

c. Elevator Contractor shall not copy, disperse, or in any way disclose, any of The University of Oregon' information to any person(s) or company, unless such information has been given, either verbal or written to such person by The University of Oregon and The University of Oregon does not consider such information as confidential.

d. All printed information that is the property of The University of Oregon.

e. All The University of Oregon' property.

2. Elevator Contractor shall maintain all confidential information in strict confidence. Elevator Contractor shall take all reasonable steps to ensure that no unauthorized person or entity has access to confidential information, and that all authorized persons having access to confidential information refrain from any unauthorized disclosure. Without limiting or otherwise affecting the relationship of the Parties to this Warranty Period, The University of Oregon may require each of Elevator Contractor's employees performing Work to sign a Nondisclosure Agreement

3. The provision of this shall not apply to any information that:

a. Is rightfully known to Elevator Contractor prior to disclosure by The University of Oregon.

b. Is rightfully obtained by Elevator Contractor from any third party.

c. Is made available by The University of Oregon to the public without restriction.

d. Is disclosed by Elevator Contractor with the prior written permission of The University of Oregon.

e. Is independently developed by Elevator Contractor without the use or benefit of the confidential information provided by The University of Oregon.

V. EXAMINATION OF RECORDS

1. The University of Oregon shall have the right to examine or audit any directly pertinent books, documents, papers and records of Elevator Contractor involving transactions

related to this Warranty Period Warranty Period for one year after expiration of this Warranty Period.

W. INSURANCE

1. Elevator Contractor shall take out and maintain, during the life of this Warranty Period, Workmen's Compensation Insurance with statutory limits set by the State of Oregon laws for the protection of their employees.

2. Elevator Contractor shall carry a Comprehensive General Liability policy including completed operations, blanket contractual, broad form property damage and protective liability in a casualty or liability insurance company acceptable to The University of Oregon, which insurance shall fully protect Elevator Contractor any Subcontractor performing the work covered by this Warranty Period, The University of Oregon and Elevator Consultant from all loss and liability.

3. Elevator Contractor shall not commence work under this Warranty Period until it has obtained all insurance required hereunder. Elevator Contractor shall provide and maintain, until the work covered in this Warranty Period is completed and accepted by The University of Oregon and Elevator Consultant, the minimum insurance coverage as follows:

	TYPE OF COVERAGE	LIMITS OF LIABILITY
a.	WORKMEN'S COMPENSATION	STATUTORY
b.	EMPLOYER'S LIABILITY	$2,000,000

c. COMPREHENSIVE COMMERCIAL LIABILITY INCLUDING BLANKET CONTRACTUAL COMPLETED OPERATIONS, PRODUCTS INJURY AND INDEPENDENT SERVICE PROVIDER, COMBINED BODILY INJURY AND PROPERTY DAMAGE

(1) Per Occurrence: $2,000,000

(2) Aggregate: $5,000,000

d. COMPREHENSIVE AUTOMOBILE LIABILITY

(1) BODILY INJURY:

(a) $1,000,000 Each Person

(b) $2,000,000 Each Occurance

(2) PROPERTY DAMAGE: $2,000,000 Each Occurrence.

(3) UMBRELLA LIABILITY COVERAGE: $5,000,000

4. Elevator Contractor shall file with The University of Oregon and Elevator Consultant, a Certificate of Insurance from their insurance company, stating that such insurance is being carried and that The University of Oregon and Elevator Consultant will be notified at least thirty (30) days prior to any cancellation.

5. The Insurance Certificate shall state, "Such policies are primary and any insurance carried by, The University of Oregon and its agent(s), is secondary and non-contributing with such policies."

6. Elevator Contractor shall carry the above indicated insurance at its own expense.

7. All insurance shall be provided by responsible insurance companies qualified to do business in the State of Oregon.

X. INDEMNIFICATION

1. Elevator Contractor hereby agrees to defend, indemnify, and hold harmless The University of Oregon and The University of Oregon' employees ("Indemnified Parties") from and against all claims, liabilities, damages, expenses, causes of action, judgments, as well as cost (including reasonable attorney's fees incurred on such claims and in proving the right to indemnification) arising directly or indirectly out of any negligent act, error, or omission of Elevator Contractor or Elevator Contractor's subcontractors, employees, or agents ("lndemnitor"). Elevator Contractor will fully indemnify the Indemnified Parties for the sole negligence of the lndemnitor. Elevator Contractor will indemnify the Indemnified Parties for the concurrent negligence of the lndemnitor to the extent of the lndemnitor's negligence.

2. The University of Oregon shall provide Elevator Contractor prompt notice of any claim or liability hereby indemnified against Elevator contractor and thereupon, Elevator Contractor shall be responsible to control and assume full liability for the defense of such matter. The indemnity contained herein shall not be deemed to be a waiver of, or in

3. limitation or, and other rights of The University of Oregon may have. To the extent a court or arbitrator strikes any portion of this indemnification provision for any reason, all remaining provisions shall retain their vitality and effect.

Y. COSTS AND ATTORNEYS FEES

1. In the event either party fails to perform its duties or obligations under this Warranty Period, or if either party breaches the terms and conditions of this Warranty Period, the prevailing party of any Warranty Period dispute shall be awarded its reasonable costs and attorney fees associated therewith.

Z. DISPUTE RESOLUTION AND APPLICABLE LAW

1. Except in the case of an emergency, if the Elevator Contractor believes it is entitled to additional compensation for any work, it shall provide The University of Oregon with written notice of such claim prior to proceeding with the work. The written notice shall include the reason that the Elevator Contractor considers to work to be an additional cost

and an estimate of such costs. Failure to provide such timely, written notice shall constitute a conclusive waiver of the right to seek compensation for such claim. If the claim is rejected, the Elevator Contractor may bring no litigation against The University of Oregon unless the claim is first subject to non-binding mediation under the Construction Mediation Rules of the American Arbitration Association ("AAA"). The Elevator Contractor is responsible for initiating the mediation process. This requirement cannot be waived except by an explicit written waiver signed by The University of Oregon and the Elevator Contractor. If the parties are unable to agree to a mediator within thirty (30) days after The University of Oregon' receipt of the written request for mediation, either party may submit a request for mediation to the AAA. Each party must attend the mediation session with a person having full authority to settle the claim. All claims that are not resolved through such mediation shall be subject to litigation in Lane County Superior Court.

2. The Warranty Period shall be construed, interpreted, and governed by the laws and regulation of the State of Oregon, without regard to its choice of law provisions.

AA. ELEVATOR CONTRACTORS EMPLOYEES' SAFETY AND ACCIDENT PREVENTION PROGRAM

1. Elevator Contractor shall submit, for review, to The University of Oregon, the Elevator Contractors Employees' Safety and Accident Prevention Program. Document shall be up-dated when any changes in the Program are adopted by Elevator Contractor.

2. Elevator Contractor shall verify, in writing, that all Elevator Contractors personnel that perform any work under this Warranty Period have completed the Elevator Contractors required training under this Safety and Accident Prevention Program and that the Employee shall receive additional on-going and future training under the Elevator Contractor's Safety and Accident Prevention Program.

BB. NO DISCRIMINATION

1. Elevator Contractor will not discriminate against any employee or applicant for employment by Elevator Contractor because of race, creed, color, age, sex, marital status or national origin. Elevator Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, sex, marital status or national origin. Elevator Contractor agrees to post in conspicuous places notices setting forth the provisions of this Section.

CC. MATERIALS

1. Elevator Contractor shall maintain an inventory level of spare/replacement elevator parts or become on-site which will permit prompt repair or replacement of components that fail worn. The elevator shall not be left shut down more than four {4) hours because of spare (replacement) parts not on-site.

2. Elevator Contractor shall mark and identify all lubricating oils and cleaning solvents that are stored on-site. All storage cans shall be Code approved. All unmarked cans shall be

removed from The University of Oregon' premises. Elevator machine/control room shall not be used for storage of materials or items that do not pertain to the elevator maintenance of The University of Oregon' elevators.

3. In performing the Work indicated in these specifications, Elevator Contractor agrees to provide only manufacturer approved replacement parts used by the manufacturers of the equipment for replacement or repair, and to use only those lubricants obtained from and/or recommended by the manufacturer of the equipment. If Elevator Contractor wishes to provide replacement parts or lubricants other than recommended by the Elevator Manufacturer, Elevator Contractor shall, in writing, state the type proposed and the lubrication specifications to The University of Oregon for review and written approval. These replacement parts shall not be considered an upgrade of elevator equipment and shall be provided by Elevator Contractor at no additional cost to The University of Oregon.

4. Contractor shall procure replacements parts in the most expeditious manner available. Parts requiring repair shall be rebuilt to an "as new" condition.

5. Elevator Contractor shall maintain on site or at their local office, at all times, a sufficient amount of replacement parts, by the original manufacturer, to maintain the equipment in first-class and safe operating condition, at all times. The minimum inventory shall include, but not be limited to, the following minimum replacement parts of each type of elevator:

a.	1	Door Operator-each type/model,complete.
b.	1	Car Door Detector, complete.
c.	4	Car Door Rollers-each type.
d.	6	Hoistway Door Hanger Rollers-each type.
e.	4	Hoistway Door Closures-each type.
f.	2	Car Roller Guides.
g.	4	Electrical Mechanical Hoistway Door lntertocks-each type.
h.	4	Hoistway and Car Door Gibs-each type.
i.	2	Hall and Car Push-Button Replacement Parts-each type.
j.	1	Hoistway Limit Switches Parts-each type.
k.	1	Hoistway Slowdown Switches Parts-each type.
l.	2	Each of Electrical Relays.
m.	1	Each of all Solid State Circuit Boards-for each type.

n. Ample Supply of Lubricants and Cleaning Material.

DD. MICROPROCESSORS

1. Elevator Contractor shall maintain, in stock, available for immediate usage, an inventory of replacement parts for any microprocessor/solid state equipment used for each elevator system. This includes all solid-state boards located in the machine/control room, fixture stations, car tops or any other location.

2. Elevator Contractor's service technicians shall carry diagnostic equipment designed to analyze programming and microprocessor functions and malfunctions on all elevator equipment.

3. Elevator Contractor shall pay for all costs if the original elevator manufacture must be brought on-site to re-program the elevator system or be required to place the elevator in service.

1.10 SUBMITTALS

A. Submit the following in accordance with Division 1 Section "Submittal Procedures."

B. Product data for each elevator including capacities, sizes, performances, operations, safety features, features of control system, finishes, and similar information.

C. Shop drawings for each elevator showing plans, elevations, sections, and large scale details indicating service at each landing, coordination with building structure, and relationships with other construction. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and locations of signals. Include maximum and average power demands.

D. Samples: Submit samples of all finish materials, catalog cuts or drawings of all signal, car, and hoistway control devices.

E. Diagrams: Furnish a complete, as-installed, single line electrical wiring diagram for elevator power signal and control systems, differentiating between manufacturer installed wiring and field-installed wiring.

F. Parts List: Prior to Substantial Completion, submit parts list of all replaceable parts and lubrication requirements, neatly bound in a durable cover.

G. Inspection and acceptance certificates and operating permits are required by governing authorities for normal, unrestricted elevator use.

1.11 QUALITY ASSURANCE

A. Elevator Contractor shall furnish Owner with all special tools, meters, diagnostic tools/devices, troubleshooting special hand-held tools/devices, printed information, adjusting information and all other special tools/devices to perform maintenance, troubleshooting, repairing and adjusting at conclusion of elevator new installation. If any special tool, meter, diagnostic tools/device

requires readjusting or re-programming Elevator Contractor shall pay for all costs including freight for a period of five (5) years from date of elevator final acceptance by Architect and Elevator Consulting Services, Inc. Cost, if any to Owner, for the above stated items shall be included in Base Bid. After the initial five (5) year period all upgrades, readjustments or reprogramming of any or all diagnostic tools or devices will be provided as needed or required on a purchase order basis with the original Elevator Contractor that installed/manufactured the elevator equipment.

B. Elevator Contractor shall provide and install all software improvement up-grades for a period of five (5) years from date of elevator final acceptance by Architect, State of Oregon Elevator Inspector and Elevator Consulting Services, Inc. The up-grades are defined as improvements for the elevator operation. If any elevator safety software up-grades are designed or discovered by the elevator manufacturer, the up-grades shall be installed immediately. Elevator Contractor shall pay all costs of the software up-grades.

C. Elevator Contractor shall provide Owner the ability to purchase and receive all elevator replacement parts withintwenty four (24) hours from date of parts order by Owner. Replacement and spare parts are defined as any and all items required to maintain, service, repair, adjust and operate the elevator as designed and installed, in a safe and trouble-free manner. Elevator Contractor shall sell any and all spare parts including proprietary parts to Owner during the entire life cycle of the elevator equipment.

1. Elevator Contractor shall provide, in writing, a list of all proprietary equipment that shall be provided, together with a guarantee of availability. This guarantee shall specify that all proprietary parts will be available within a twenty four (24) hour period of order placed. Owner may return the worn or defective part to Elevator Contractor after the replaced part is delivered to Owner and the elevator has been placed in normal operation. Elevator Contractor shall submit a list of all proprietary equipment that is required in the elevator drive and control system. The list shall include individual item cost and part numbers or coding. Parts ordering information shall be provided.

1.12 ACCEPTABLE ELEVATOR EQUIPMENT MANUFACTURERS

A. Controls/hydraulic machine/rails/car safeties/etc:

1. Otis Elevator Company.

2. Kone Elevator.

3. ThyssenKrupp Elevator.

4. Motion Control Engineering, lnc.

B. Car Roller Guides:

1. Otis Elevator Company.

2. Kone Elevator.

3. ThyssenKrupp Elevator.

4. Motion Control Engineering, lnc.

5. ELSCO.

C. Operating Fixtures-Vandal Resistant:

1. Otis Elevator Company..

2. ThyssenKrupp Elevator.

3. Motion Control Engineering, lnc.

4. Innovation Industries Inc.

D. Hall Lanterns-Vandal Resistant:

1. Otis Elevator Company.

2. Kone Elevator.

3. ThyssenKrupp Elevator.

4. Motion Control Engineering, lnc..

5. Innovation Industries Inc.

E. Car Door Protective Device: Janus-Panachrorne 3D.

F. Car Door Operator:

1. Otis Elevator Company.

2. ThyssenKrupp Elevator.

3. Kone Elevator.

4. Motion Control Engineering, lnc.

5. GAL-Manufacturing Company.

G. Hoistway Door Tracks, Hangers, Interlocks:

1. Otis Elevator Company.

2. Kone Elevator.

3. ThyssenKrupp Elevator.

4. Motion Control Engineering, lnc.

5. GAL. Manufacturing Company.

H. Car Door Tracks, Hangers, Gate Switch:

1. Otis Elevator Company.

2. Kone Elevator.

3. ThyssenKrupp Elevator.

4. Motion Control Engineering, lnc.

5. GAL. Manufacturing Company.

I. Cab:

1. Hauenstein and Burmeister.

2. Custom Cabs, Inc.

3. Winter and Bain.

4. Hoistway and Car Door Gibs:

5. Southern Elevator and Electric Supply (SEES-The Enforcer).

J. Hoistway Door Escutcheons: Tri-Lok Mfg. & Maintenance Corp. 625 Fifth Avenue-Pelham, New York, 10803.

K. Car/Hall Position Indicators/Signals-Vandal Resistant:

1. Otis Elevator Company .

2. Kone Elevator.

3. ThyssenKrupp Elevator .

4. Motion Control Engineering, lnc..

5. C. E. Electronics, Inc.

L. Alarm Bell: Nylube Products Model ELB-6.

M. In Car ADA Emergency Communication: Ramtel Corp. Model RR733-924M.

N. In Car Emergency Lighting:

1. Otis Elevator Company .

2. Kone Elevator.

3. ThyssenKrupp Elevator .

4. Motion Control Engineering, lnc.

5. Nylube Products Model EL-SS.

O. In-Car Exhaust Fan:

1. Otis Elevator Company.

2. Kone Elevator.

3. ThyssenKrupp Elevator.

4. Motion Control Engineering, lnc.

5. Nylube X12F9.

P. Intercom:

1. Otis Elevator Company .

2. Kone Elevator.

3. ThyssenKrupp Elevator.

4. Motion Control Engineering, lnc..

5. JFillips LLC.

Q. Stainless Steel: Vandal Resistant 5SM or 5WL.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. General: The completed elevator installation shall conform to the Elevator Safety Code except where explicitly indicated or specified otherwise. The new installation, including equipment, material, workmanship, design, and tests shall be in accordance with the standards, rules and Specifications referenced. All material and equipment shall be new. Electrical materials shall meet and bear evidence of meeting the requirements of Underwriter's Laboratories. The equipment shall be the product of a manufacturer regularly engaged in the manufacture of new installation of this type of equipment. Working parts shall be accessible for inspection, servicing and repair. Adequate means shall be provided for the lubrication of all wearing parts that require lubrication.

B. ELEV-1, Description and Performance: New installation will be in accordance with the following details and consist of one (1) Elevator.

1. Basis of Design Elevator Model: Otis Hydrofit.

2. Equipment Control: Elevonic Control System.

3. Quantity and Type: One telescopic holeless hydraulic.

4. Capacity: 2,100 lbs.

5. Speed: 100 fpm up; 125 fpm down.

6. Travel: Distance of 12- feet 6-inches.

7. Openings: Two in line.

8. Operation: Automatic single car.

9. Clear Car Inside: 5' – 8-1/16" wide x 4' – 3-1/16" deep

10. Cab Height: 8'-0” nominal.

11. Hoistway Entrances:

    a. Size: 3 feet-0-inches wide x 7 feet high.

    b. Type: Single-slide, side opening.

12. Power Supply: 480 volts, 3 phase, 60 Hz.

13. Lighting: 120 volts, 60 Hz.

14. Machine and Controller Location: No machine room required, tank and controller in hoistway pit.

15. Signal Fixtures: Vandal resistant.

16. Controller Location: Inside hoistway, accessible by a door in a side hoistway wall on the 1st or 2nd landing.

17. Stopping Accuracy: ±1/4" (6.4 mm) under any loading condition or direction of travel.

18. Additional Features: As specified herein.

19. Capacity: Safely lower, stop, and hold up to 125% rated load.

20. Door Opening Time: 4.5 seconds from start of opening to fully open. 5.0 seconds closing.

21. The elevator shall ascend at an approximate speed of 100 feet per minute. A variation of 10% above or below this speed shall be permitted as loads are varied up to capacity.

2.2 GENERAL MATERIALS

A. Steel:

1. Sheet Steel: Furniture Steel for Exposed Work: Stretcher-leveled, cold-rolled, commercial- quality carbon steel, complying with ASTM A366, matte finish.

2. Sheet Steel: For Unexposed Work: Hot-rolled, commercial-quality carbon steel, pickled and oiled, complying with ASTM A569.

3. Structural Steel Shapes and Plates: ASTM A6, ASTM A36 AND ASTM A108.

B. Stainless Steel:

1. Type 302 or 304 complying with ASTM A167, with standard tempers and hardness required for fabrication, strength and durability.

2. Apply No. 4 satin mechanical finish on fabricated Work in the locations shown or specified. Federal Standard and NMMM nomenclature. Protect with adhesive-paper covering until final inspection.

C. Fastening Screws: Stainless Steel tamper-proof screws shall be used throughout for all face plates.

D. LEDs: All LEDs shall be 100,000-hour long-life.

E. Keys: All elevator keys shall be Elevator Products Company (EPCO) #2, as manufactured by Chicago Lock Company, for Fire Fighters' Service, Phase I and Phase II and Elevator Products Co. #1 for all other keys. In car locked service cabinet shall have Elevator Products Company (EPCO) #1 key. Provide three (3) keys of each type on a three inch (3”) steel disk with engraved function of keys. Engrave with each key set the number and/or function of the key.

F. Signs: Provide sign on outside of the control room door stating “Authorized Personnel Only-Storage or Installation of Equipment Not Pertaining to the Elevator is Prohibited". Letters shall be not less than 3/8" high. Sign shall be plastic or metal and securely fastened so as not to be readily removed without the use of special tools.

G. Key Box:

1. Provide a key box adjacent to control room access door. Provide all elevator keys inside box including control room access key as required by ASME A17.1. Box size and color to be directed by State of Oregon Elevator Inspector.

2. Provide key box(s) at other locations as required by the State of Oregon Elevator Inspector. Provide all required keys in box.

3. Provide, in the elevator control room, all required sets of keys with marking tags as required by the State of Oregon Elevator Inspector.

H. Finishes: Structural members and other components for which finish is not otherwise specified shall have prime coat finish.

2.3 ELEVATOR MACHINERY

A. Car Guide Rails and Brackets:

1. Guide rails shall be clean and free on any signs of rust, grease or abrasion.

2. Provide all T-guide rails and brackets. Tram all guide rails to +or - one thirty second of an inch (1/32") DBG. Maintain guide rails not more than three sixteenths of an inch (3/16") out of vertical plumb. File all joints-area to file shall be at least sixteen inches (16•) above and sixteen inches (16") below each joint. Power disk sander shall not be allowed to file joints. Flat file that is enclosed in a Rail File Holder shall be the method of filing rail joints.

3. Provide bevel washers for any bolt/nut that is installed in a plane of five (5) degrees or greater.

4. Provide vertical spacing of guide rail brackets as required by ASME A17. 1. Provide any required guide rail backing to secure the guide rail rigidity required for bracket spacing.

5. Clean and paint guide rails, fishplates and brackets with one coat of light gray enamel. Do not paint running surface of guide rails

6. Paint spreader beams with one coat of light gray enamel.

B. Limit Switches:

1. Provide upper and lower final and terminal limit switches with rollers having rubber or other approved composition to provide silent operation when activated.

2. Normal terminal stopping devices shall be provided and arranged to stop the car automatically from any speed obtained under normal operation within the top and bottom over-travels, independent of the operating devices, final terminal stopping device and the buffers.

3. Final terminal stopping devices shall be provided and arranged to stop the car automatically from the speed specified within the top clearance and bottom over-travel independent of the operation of the normal terminal stopping device but with the buffers operative.

C. HOISTWAY EQUIPMENT

D. Frames:

1. Provide U.L. rated hollow metal, bolted, fabricated from not less than No. fourteen (14) gauge material to form a one-piece unit. Permanently attach handicapped floor designations two inches (2") high, raised three one hundredths of an inch (0.030"), with lettering, style and color selected by Architect, sixty inches (60") above the floor.

2. Finish to be No.4 Stainless Steel.

E. Door Tracks: Provide bar or formed, cold drawn steel with smooth hanger contact surface. Provide removable type tracks.

F. Interlocks:

1. Provide approved U.L. rated and approved interlock for each hoistway entrance.

2. The interlock shall prevent operation of the elevator unless all doors are in the closed and locked position.

3. Provide Fire Rated electrical wires from all interlocks. The conductors shall be flame-retardant and suitable for a temperature on not less than 392 degrees F. Conductors shall be Type SF or equivalent.

4. Provide electrical ground wire from each interlock to the elevator controller. Electrical ground wire shall be a green colored conductor that connects all interlocks and terminates in the elevator controller at an electrical lug that designates electrical ground as defined by the N.E.C.

G. Emergency Access:

1. Provide access to all hoistway doors by mechanical luner key. Provide door luner key holes with Safety Plug Locks.

2. Provide access to hoistway at terminal as required by ASME A 17.1-8evator Code.

H. Door Closers: Provide door spirator closures.

I. Door Panels:

1. Provide No. sixteen (16) gauge steel, one and one quarter inch (1 1/4") thick fabricated with vertical internal channel reinforcements spaced at not more than six inches (6") on centers and welded to face sheets.

2. Provide two (2) gibs per door panel-one at the leading edge and one at the trailing edge, including fire tabs.

3. Provide 1/8" thick steel plate gibs between each standard door gib. Plate shall span the "total" distance between each standard door gibs. Plates shall vertically penetrate into the hoistway door sill groove the maximum vertical depth without bottoming out on the groove.

4. Provide door retainer plates that insert into the door frame when the door is in the closed position. Provide two (2) door retainr plates oer hoistwav cinnr

5. Finish shall be 5SM Stainless Steel.

J. Sills:

1. Provide aluminum sills with non-slip wearing surfaces and grooves for the door guides.

2. Sills shall be provided with water slots/holes for water to pass through the sills.

3. Sills shall be supported on steel channels or angles, furnished and installed by Elevator Contractor. General Contractor shall provide support for the rough sills.

4. The sill length will be approximately the hoistway width.

K. Fascia, and Hanger Covers:

1. No. 14 gauge furniture steel. Paint hoistway side with black enamel. Make hanger covers same width as fascia.

L. Toe Guard:

1. A toe guard, fabricated from No. 14 gauge steel shall be furnished.

M. Dust Cover:

1. A dust cover, fabricated from No. 14 gauge steel shall be furnished. Paint hoistway side with black enamel.

N. Struts:

1. Strut angles or channels shall be of sufficient size to support the entrance and shall be securely fastened to the building structure or guide rails.

2. Provide door open bumpers on the vertical struts. Paint struts with black enamel.

O. Headers:

1. Headers of sufficient size and thickness to provide support for the door frames and hangers, shall be securely fastened to the strut angles or channels.

P. Floor Numbers:

1. Provide numbers per ASME A17. 1.

2.4 LANDING CONTROL STATION

A. Provide "flush" mounted hall stations at each floor as noted on the drawings. LED's shall be provided to illuminate when the hall push button(s) are activated. Include pushbuttons for each direction of travel.

B. Engrave safety message "In Case of Fire..." (per ASME A 17.1) on push-button faceplate. Height and width of sign to be three and a half inches (3-1/2") wide by four inches (4") high. Provide Braille and UP & ON. marking inserts to the left of each button. Locate each hall station as allowed by the ADA from floor level.

C. Provide intercom between main floor lobby and elevator car. Lobby speaker and selection switch shall be part of the main floor hall station. Provide ON-OFF toggle switch to allow communication between lobby station and elevator. Provide manual operated selection switch engrave in one-quarter inch (1/4") letters near Intercom.

D. Provide Phase I Firefighters' Service key switch with engraved instruction at the Main Recall-Firefighter's Service-Phase I floor hall station.

E. Provide No.4 Stainless Steel cover plates. Provide vandal resistant No.4 Stainless Steel fastening screws on cover plate.

2.5 SIGNALS

A. Car Position Indicator: Provide as part of all car station, located at the upper area of station.

B. Car Traveling Lanterns: Provide vertical type directional arrows, vandal resistant, in all car front entrance frames. Provide the single and double gongs for car travel direction. Provided No.4 Stainless Steel Cover plate with vandal resistant fastenings.

2.6 INTERCOMS

A. Provide intercom between main floor lobby and elevator car.

B. Provide elevator car to control room intercom. Provide selection switch to allow communication between control room and the elevator from elevator control room.

2.7 SEISMIC REQUIREMENTS

A. Guarding Of Snag Points: Provide guards to prevent the governor rope and electrical traveling cables from becoming snagged on guide rail brackets as required by ASME A17.1.

B. Guide Rail Fishplates:

1. Provide car guide rail fishplates and bolts as required by ASME A17.1.

2. The section modules and the movement inertia of the fishplate shall not be less than that of the guiderail.

3. The diameter of bolts holes shall not exceed the diameter of the bolts by more than one eighth of an inch (1/8") for fishplates.

4. The threaded portion of the fishplate bolts shall not occur in the shear plane of the guide rail fishplate assembly.

2.8 PIT

A. Emergency Stop Switch: Provide emergency stop switch as required by ASME A 17.1.

B. Locate stop switch one foot eight inches (1'-8") above the access floor level and the second switch four feet zero inches (4’-0”}above the floor of the pit and adjacent to the pit ladder.

C. Car Buffers:

1. Provide buffers for car speed and capacity. Provide pit channels. Perform full load safety tests. Paint buffers and pit channels with one coat of light gray enamel.

2. Provide bevel washers for any bolt/nut that is installed in a plane of five (5) degrees or greater.

3. Provide all ASME A17.1 tags on car buffers.

D. Pit Ladder:

1. Provide a non-combustible pit ladder to a minimum height of forty eight inches (48") above the sill of pit access hoistway door. Overall width of ladder shall be sixteen inches (16"). Distance vertically of rung to rung shall be twelve inches (12"). Distance of outside of each rung to hoistway wall shall be not less than seven inches (7").

2.9 ELEVATOR CAR

A. Car Sling:

1. A suitable frame fabricated from formed or structure steel members shall be provided with adequate bracing to support the platform and car enclosure.

2. Provide bevel washers for any bolt/not that is installed in a plane of five (5) degrees or greater.

B. Buffer Striking Plates:

1. Provide plates that will come into contact with the oil buffers and be able to withstand the full impact force without bending or being out of alignment.

2. Provide bevel washers for any bolt/not that is installed in a plane of five (5) degrees or greater.

C. Platform:

1. A platform for specified capacity shall be provided. The platform shall consist of a steel frame with and steel sub floor.

2. The underside of the platform shall be properly fireproofed. The platform connection to the frame assembly shall be isolated.

3. The support frame shall carry isolation pads on which the platform shall rest without any metal connection to the steel frame. Isolation pads shall effectively isolate the cab from the frame assembly.

4. All auxiliary apparatus shall be substantially supported. Provide bevel washers for any bolt/not that is installed in a plane of five (5) degrees or greater.

D. Door Operator:

1. Provide a door operator with direct current motor to open and close the car and hoistway doors simultaneously. The package shall include the following: lifting rods, pickup rollers, clutch assembly, interlocks with anti-egress device, car door electrical switch and all related hardware.

2. Closing speed shall not exceed the limitations set by the Elevator Safety Code. Car door operator shall be capable of closing doors under hoistway pressurization mode, including Firefighters Service operation without slamming in open and close sequence and also under non-pressurization mode without slamming in either open or close sequence without external adjustment.

3. Doors shall be designed to accommodate hoistway pressurization of 0.10 inches water column while remaining fully operational. Doors shall be designed for low air leakage under pressurization mode.

E. Elevator Car Station:

1. Provide one (1) vandal resistant elevator control station with faceplate, consisting of a metal box containing the operating fixtures, mounted behind the non-swing (fixed) car enclosure front panel.

2. Install in-car to lobby intercom as part of the elevator car station.

3. Provide two inch (2") high digital position indicator as part of the car station, located in the top area of the car station.

4. Emergency Car lighting: An emergency power unit shall be provided to illuminate the elevator car and provide current to the alarm bell in the event of power failure. If emergency power circuit is available, car lighting and alarm bell also shall be connected to the Building Emergency Panel. Device shall be built in and part of the car operating station at the upper section of the station cover. Device shall provide lighting of .02 ftc at a distance of four feet (4') above the car floor and one foot (1') in front of the car operating station. The emergency lighting shall maintain the light intensity for a minimum period of four (4) hours.

5. Suitably identify round floor buttons, lighted alarm button, door open button, door close button and keyed emergency stop switch by engraved and painted letters or symbols per

local Handicapped Standards and ADA requirements. Provide flush inset, back fastened handicapped markings. Locate all car-operating devices vertically from the cab floor as required by ADA requirements. Engrave below door open, door close and alarm in one quarter inch (1/4") letters-"Door Open", "Door Close" and "Alarm".

6. Provide one eighth inch (1/8") raised floor pushbuttons which illuminate to indicate LED call registration. Provide floor designation engraved plates to the left of each button.

7. Provide door hold open button with adjustable timing features.

8. Provide illuminated alarm button at bottom of station to sound distress signal alarm located on the car top. Provide a signal to the elevator controller at a terminal strip for monitoring purposes of alarm at a remote location.

9. Provide keyed stop switch in panel faceplate with markings to show "Run" and "Stop" positions.

10. Provide door open button to stop and reopen closing doors. Make button operable while car is stopped at landing, regardless of special operational features, except Firefighters' Service.

11. Provide one (1) Firefighters' Service Phase II key switch with engraved instructions, light jewel, buzzer and call cancel button. Provide Firefighter's phone jack plug in car station with electrical conductors to elevator controller.

12. Provide lockable service panel with recessed flush cover plate. Include the following controls, with purpose and operating positions identified by engraved letters painted black:

    a. Three position fan switch-Low speed-High speed-Off.

    b. Independent service switch to permit selection of independent or automatic operation.

    c. Start button for closing doors and starting elevator when operating on independent service. Floor pushbuttons may be used for this function.

    d. Duplex 120 VAC electrical convenience outlet. Provide GFCI protection.

    e. Switch to test the in-car emergency lighting fixture. Electrical switch shall interrupt the actual lighting circuit to the car.

13. Provide black paint filled engraving with size and style approved by Architect and Elevator Consultant as follows:

    a. Elevator number on car station.

    b. Inlaid capacity plate.

c. Faceplate Material and Finish: No. 4 Stainless Steel.

14. Telephone Cabinet: An ADA approved telephone shall be mounted beneath and as part of the car operating panel. Provide all required electrical wiring from ADA phone to the elevator controller. Phone shall be mounted such that it is easily removable for servicing from within the cab without having to remove cab walls or hardware. Provide all labor/material to program phone.

F. Car Enclosure:

1. The car enclosure shall be steel and shall comply with the Elevator Safety Code. Exterior of cab enclosure shall receive a sound deadening material coating.

2. Car Top: The car top shall not be thinner than fourteen (14) gauge cold-rolled steel suitably reinforced.

3. Interior Car Lighting: Provide integrated LED car lighting fixtures.

4. Provide aluminum car sill. Provide Stainless Steel through bolts for sill fastening to car platform.

5. Car Handrails: One and one-half inch (1-1/2") diameter round stainless steel handrails shall be provided on all walls. Handrail shall be spaced one and one-half inch (1-1/2”) off walls and at a height of thirty two inches (32") from cab floor to the handrail top. Steel backing plates, four inches (4") square x one quarter inch (1/4") thick, shall be provided on the hoistway side of the cab walls to fasten the handrails. No fastening device, set screw- etc., shall be allowed inside the cab. Handrail, standoff section and mountings stud shall all be as one unit.

6. Wall Finish: Plastic laminate wall panels with Formica, color as selected by Architect from manufacturer’s full color range with 1-inch wide 5SM or 5WL vandal resistant stainless steel reveals.

7. Side Wall Base: Six inches high #4 satin finish stainless steel base with screened vent slots.

8. Car Doors: Provide 5SM or 5WL vandal resistant stainless steel finish. Provide doors with two gibs-one at the leading edge and one at the trailing edge. Provide a steel plate gib the total between each of the two gibs.

9. Car Front Panel and Transom: Provide 5SM or 5WL vandal resistant stainless steel finish.

10. Floor Finish: To accommodate 1/8 inch thick flooring furnished and installed under Section 09 65 00.

11. Ceiling: Provide flat ceiling or a ceiling similar to the Otis FC-4 flush ceiling. No suspended/drop ceiling allowed.

12. Protective Pad and Pad Hooks: Provide stainless steel pad hooks for all walls and front panels including car station. Pad hooks shall be through bolted to cab walls. Pad hook and mounting stud shall be one piece. Provide one (1), fire retardant pad with metal grommet holes for the pad hooks fastening. Mark on back side of pad the exact location of each pad.

13. Exhaust Fan: Provide a two-speed exhaust fan to be mounted on the car top.

14. Car Top Exit: Provide lock and electrical switch to comply with ASME A17. 1-Seismic Requirements.

15. Provide a 4 inch x 3/8 inch solid No. 4 satin finish stainless steel flat stock bar at 8 inches above the car floor on 1-1/2 inches deep round standoff spaces at no more than 18 inches on center. Steel backing plates, four inches (4") square x one quarter inch (114) thick, shall be provided on the hoistway side of the cab walls to fasten the rail. No fastening device, set screw-etc. shall be allowed inside the cab. Rail, standoff section and mounting stud shall all be as one unit. Mounting studs shall be a minimum of 3/8 inch diameter.

G. Car Top Control Station:

1. Operating fixture shall be provided containing continuous pressure Up, Down and Safe buttons, emergency stop switch, inspection and run switch, work light with guard and 110 VAC duplex outlet with GFCI protection.

2. Toggle switches shall not be provided for the Stop, Run and Inspection switches unless the switches are guarded against accidental activation.

3. Fasten car top station to car crosshead.

4. Work light shall be encased in a total glass enclosure including a wire guard cover. Rating of light to be a minimum of 60 W.

5. Provide additional light fixture on a flexible cord. Length of cord to be eight feet (8'). Size of conductors to be minimum of 12 G. Cord to be hard wired into car top foced work light. Provide fixed metal bracket to store cord when not in use. Locate bracket to avoid stepping on cord when attached to bracket. ON-OFF car top light switch shall control both fixtures. Provide guard on light. Rating of light to be a minimum of 60 W.

H. Alarm Bell: Furnish and install an alarm bell, located on top of the elevator adjacent to the car top inspection station.

2.10 POWER AND CONTROL DEVICES

A. Controller:

1. The solid-state power control shall be a closed feedback loop design. It shall be a compact self-contained unit that will provide step-less acceleration and deceleration and provide regulation at all speeds.

2. The system shall provide the required electrical operation of the elevator control system including the automatic application of the brake, which shall bring the car to rest upon failure of power. In addition, the power control shall be arranged to continuously monitor the actual elevator speed signal from the tachometer and to compare it with the hoist motor and the intended speed signal, to verify safe and proper operation of the elevator.

3. Provide isolation transformer and any required line inductors to eliminate both electrical and audible noise.

B. Nudging Feature:

1. Should the doors be held open for a predetermined adjustable time, a buzzer shall sound and the doors shall close at a reduced torque. Activation of the door detector shall be ignored. The door open button shall remain in normal service.

C. Simplex Selective Collective Operation:

1. Operation of one or more car or hall call pushbuttons shall cause the car to start and run automatically, provided the hoistway door interlocks and car doors contacts are closed. The car shall stop at the first car or hall call set for the direction of travel. Stops shall be made in the order in which car or hall calls set for the direction of travel are reached, regardless of the order in which they were registered. If only hall calls set for the opposite direction of travel of the elevator exist ahead of the car, the car shall proceed to the most distant hall call, reverse direction, and start collecting the calls.

D. Independent Service:

1. Independent service operation shall be provided through the actuation of a key switch in the car operating service panel. This service will cancel any existing car calls, and hold the doors open at the landing. The car will only respond to car calls. While on independent service the hall arrival lanterns shall be inoperative.

E. Firefighters' Service:

1. Provide elevator control functions, car operating devices, and hall operating devices necessary for "Firefighters Service-Automatic Elevators" as required by the ASME A17.1. Provide a key box, at the Designated Level and at any other location as required by ASME A17.1. Provide Firefighter's Service Phase I& II, elevator control room key and any other key required to open doors to gain access to the elevator control room in the key box.

2. Provide all required elevator components in the Fire Command Center.

F. Landing System:

1. The hoistway landing system shall use vane operated infrared optical switches to sense the position of the elevator in the hoistway. It shall provide stepping, leveling, door zone and optional floor encoding signals.

2. The vane switches shall be installed on a fourteen (14)-gauge steel enclosure with adequate adjustment capability, and shall include labeled terminals for electrical interconnection.

3. The landing system shall include vanes and mounting hardware for vane mounting in the hoistway.

4. Switches shall be accurate to .0625" (1.59mm) and the accuracy shall be the same regardless of direction of travel.

5. Switches shall not exhibit any interaction when arranged in any compact configuration.

6. Switch size shall allow horizontal spacing of lanes as close as 2" (50.8mm) center to center.

2.11 SOLID STATE POWER SUPPLY AND LOGIC CONTROL

A. Fault Diagnosis: Capability shall be provided to diagnose faults to the level of individual circuit boards and individual discreet major components for both the Solid State Power and the Elevator Logic Controller. Capability to diagnose faults within an individual circuit board is not required.) If fault diagnosis requires a separate, detachable device, it shall be furnished.

B. Reports: As a minimum, the following reports shall be provided:

1. Job Configuration: This report shall provide a brief description of the system, including the job number, programmable job name, number of cars, number of landings, openings per landing for the car, programmable car designation, programmable landing designation, Firefighter's Service, Seismic operation, serial communication port definitions and other system options.

2. System Performance Graph: This report shall provide elevator system performance data based on hall call waiting times. At the end of each hour, the number of up and down hall calls and up and down waiting time averages shall be calculated and saved in the controller's non-volatile RAM. This information shall be stored for a minimum of seven (7) days.

3. Graph Display of Elevator Status: This report shall provide a graphic display of the elevator hoistway that gives the user a comprehensive picture of car locations, door status, direction of travel, car calls registered, hall calls registered, hall call assignments, estimated time of arrival of a car for a registered hall call, wait time of a registered hall call, floor labels, system status and a car status window. A per car status window shall be provided that shows the status of the car, such as, automatic operation, inspection, firefighters' service, time out of service, top floor demand and bottom floor demand.

C. Entering Hall and Car Calls: Provide a means for entering hall and car calls.

D. Printouts: Provide permanent copy of reports. The printouts can be used for records or for ease of reference.

E. Automatic Leveling Device: The elevator shall be provided with a two-way automatic maintaining leveling device.

PART 3 EXECUTION

3.1 NEW INSTALLATION OF ELEVATOR SYSTEMS

A. General: Comply with manufacturer's instructions and the Elevator Safety Code for work required during new installation.

B. Scheduling:

1. Before commencing any Work, submit for review and approval by Architect, a schedule showing the material ship dates, time of material on-site, commencement of work, the order and the completion dates for the various parts of the elevator new installation. Provide a weekly updated schedule to Architect. Provide a list of names of adjusters, mechanics and helpers on-site. Update list of different mechanic and/or helper are changed.

2. Elevator Contractor is required to submit a three (3)-week look-ahead schedule to Architect every week, and a full project schedule with each pay request.

C. Before beginning the new installation, the Elevator Contractor shall examine the hoistway and control room to verify conditions and provide written notice to the Architect of any conditions that would substantially hinder or prevent proper execution of the work. The Elevator Contractor shall not proceed with the new installation until the cited conditions are corrected.

D. Pre-New Installation Meeting: Prior to new installation of any elevator equipment, a meeting of Architect, Elevator Contractor and Contractor shall be held to review new installation approach and identify any special circumstances pertaining to this new installation.

E. Welded Construction: Provide welded connections for new installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance and replacement of worn parts. Comply with standards of AWS 01.1for workmanship and for qualifications of welding operators.

F. Electrical Work: All work shall conform to the requirements of NEC standards. Requirements specific to Elevators include:

1. Mark each component, including but not limited to relays, switches, timers, fuses and overload devices, with permanent identification that corresponds with the nomenclature of the wiring diagrams and the operations and maintenance manuals.

2. Terminate all field wiring at the control cabinet on terminal strips suitable for the use. Field wiring shall not terminate on the studs of relays or other devices and equipment.

G. Coordination: Coordinate elevator work with work of other trades for proper time and sequence to avoid new installation delays. Sound Isolation: Mount rotating and vibrating elevator

equipment and components on vibration- absorption mounts, designed to effectively prevent transmission of vibrations to structure, and thereby eliminate sources of structure-borne noise from elevator system.

H. Lubrication: Lubricate operating parts of systems, including hoist ropes as recommended by manufacturers.

3.2 FIELD QUALITY CONTROL

A. Compliance Testing: Upon nominal completion of elevator new installation, and before permitting use of elevator {either temporary or permanent), perform acceptance tests as required and recommended by Code and governing regulations or agencies. Advise Architect and inspection departments of governing agencies, seven (7) days in advance, of dates and times tests are to be performed on elevator.

B. Acceptance Tests: Conduct operational test of car before turning elevator over to Owner. Schedule Elevator Consultant with not less than one (1) weeks' notice.

3.3 PERFORMANCE

A. Car Speed: +/- one percent (1%) of contract speed under any loading condition or direction of travel.

B. Floor Stopping Accuracy: +/- Level to one eighth inch (1/16") under any loading conditions or direction of travel.

C. Floor-to-Floor Performance Time:

1. Seconds from start of doors closing until doors are three quarters (%) open and car level and stopped at next successive floor under any loading condition or travel direction.

a. 10.5 seconds.

2. Provide a smooth start, high-speed operation and stop in both directions.

D. Door Open and Close Times:

1. Door Open: 3.5 seconds.

2. Door Close: As allowed by ADA requirements.

E. Noise Level:

1. The measured noise level in the elevator cab of elevator equipment shall not exceed sixty (60) dBA during car operating conditions and a maximum increase of seven (7) dBA during door operation

2. Maximum of eighty (80) dBA in control room.

F. Ride Quality:

1. Horizontal vibration, side-to-side and front to back with car during normal operation shall not exceed twenty five (25) mg in the 1-10 Hz range.

2. Vertical vibration not more than twenty (20) mg. Provide smooth and constant acceleration and deceleration of not more than 2.8 feet/second/second with an initial ramp between 0.5 and 0.75 second.

3. Provide smooth and constant acceleration and deceleration of not more than 2.8 feet/second/second with an initial ramp between 0.5 and 0.75 second.

4. Provide no more than 12 ft/sec3 of maximum jerk.

G. Running Test:

1. Load elevator to its rated capacity, empty car and balanced load and operate continuously for one (1) hour over its full travel distance, stopping at each landing, providing a complete door open and close cycle. Record temperature rise of motor during 60-minute test period. Record speed up and down and leveling relative to landing sills at the end of the period. Requirements are as follows:

a. Motor temperature rise within manufacturer's tolerances.

b. Speed within 1% of specified speed.

c. Leveling within +/- 1/16 inch. Record failures of elevator to perform as required.

H. Protection: At time of final completion of elevator work (or portion thereof), provide suitable protective coverings, barriers, devices, signs or such other methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of new installation period. Elevator Contractor is responsible for damage and wear during the new installation period, and shall repair or replace, to the Architect’s satisfaction, any components worn significantly or damaged before the Architect approves elevator new installation.

3.4 CONDITIONS PRECEDENT TO FINAL ACCEPTANCE

A. Instructions To Operators: The Elevator Contractor shall have completed instruction of the designated employees of Owner in the operation and care of the elevator equipment.

B. Code Compliance: All code compliance tests shall have been performed and acceptance certified by the authorities having jurisdiction and permanent elevator operating permit issued.

C. In addition to inspections and tests required by local authority, perform all applicable inspections and tests contained in Part I and Part II of ASME/ANSI A17.1, with written certificate of compliance to the Architect.

D. Submittal Of Maintenance Manuals:

1. Refer to Division 1 Section “Closeout Procedures.”

2. All manuals shall have been submitted to Elevator Consultant for review and approval. Elevator Consultant shall forward to Architect all Manuals after reviewing for total and complete Manuals submitted by Elevator Contractor.

E. Submittal of Construction Record Drawings: Construction drawings of the work shall have been marked to show changes and actual new installation conditions, sufficient to form a complete record for Architect's purposes. Give particular attention to work which will be concealed and difficult to measure and record at a later date, particularly items which may require servicing or replacement during the life of the projects.

F. Final Check: Make a final check of elevator operation, with Owner's personnel and Architect present and just prior to date of completion to determine that control systems and operating devices are functioning properly. Any and all damage and/or significant wear shall have been repaired.

G. Cleaning: The work site shall be clean. Elevator Contractor shall clear away all debris, surplus materials, etc., resulting from their work or operations, leaving the job and equipment furnished in a clean, first-class condition.

H. Punchlist: All items on the punchlist shall be completed to the satisfaction of the Architect.

I. Safety Test Report: Submit copy of Safety Test Report, within one week after testing, to Architect.

END OF SECTION

BASIC FIRE PROTECTION MATERIALS AND METHODS

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 01 - General Requirements, and shall include all Fire Protection Sections specified herein.

1.2 SCOPE OF THIS SECTION

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Compliance with all codes and standards applicable to this jurisdiction.
2. Shop Drawings for Equipment
3. Coordination Documents
4. Record Drawings
5. Start-up Service and Building Commissioning
6. Instruction, Maintenance, and O & M Manuals
7. Work associated with Delivery, Storage, and Handling of products
8. Work associated with provision of Temporary Facilities
9. Preparation of Posted Operating Instructions
10. Meeting Project Safety and Indemnity requirements
11. Proper Cleaning and Closing
12. Supplying proper Warranty information
13. Supply specified Guarantee documentation
14. Design and provision of Supports and Anchors
15. Pipe Portals
16. Access Panels and Doors
17. Identification Markers
18. Coordination of Electrical requirements for equipment provided

1.3 DESCRIPTION OF WORK

A. The Contract Documents, including Specifications and Construction Drawings, are intended to provide all material and labor to install complete fire protection systems for the building and shall interface with all existing building systems affected by new construction.

B. The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract Drawings and he shall coordinate his work with that of the other trades to avoid interference. The plans are diagrammatic and show generally the locations of the equipment, and risers and are not to be scaled; all dimensions and existing conditions shall be checked at the building.

C. The Contractor shall comply with the project closeout requirements as detailed in General Requirements of Division 01.

D. Where project involves interface with existing building and site systems, effort has been made to note existing utilities and services. However, the Contractor should thoroughly familiarize themselves with existing conditions and be aware that in some cases information is not available as to concealed conditions, which exist in portions of the existing building affected by this work.

1.4 DESCRIPTION OF BID DOCUMENTS

A. Specifications:

1. Specifications, in general, describe quality and character of materials and equipment.

2. Specifications are of simplified form and include incomplete sentences.

1.5 DEFINITIONS

A. "Above Grade": Not buried in the ground and not embedded in concrete slab on ground.

B. "Actuating" or "Control" Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

C. "Below Grade": Buried in the ground or embedded in concrete slab on ground.

D. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

E. "Connect": Complete hook-up of item with required service.

F. "Exposed": Not installed underground or "concealed."

G. "Furnish": To supply equipment and products as specified.

H. "Indicated," "Shown" or " "Noted": As indicated, shown or noted on Drawings or Specifications.

I. "Install": To erect, mount and connect complete with related accessories.

J. "Motor Controllers": Manual or magnetic starters (with or without switches), individual push buttons or hand-off-automatic (HOA) switches controlling the operation of motors.

K. "Must": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

L. “NRTL”: Nationally Recognized Testing Laboratory, including UL and/or ETL.

M. "Piping": Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

N. "Provide": To supply, install and connect as specified for a complete, safe and operationally ready system.

O. "Reviewed," "Satisfactory" or "Directed": As reviewed, satisfactory, or directed by or to Architect/Engineer/Owner.

P. "Rough-In": Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

Q. "Shall": An exhortation or command to complete the specified task.

R. "Similar" or "Equal": Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

S. "Supply": To purchase, procure, acquire and deliver complete with related accessories.

T. “Typical” or “Typ”: Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

U. "Will": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

V. "Wiring": Raceway, fittings, wire, boxes and related items.

W. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

1.6 RELATED WORK SPECIFIED ELSEWHERE

A. All Division 21 Fire Suppression sections included herein.

B. Division 02: Existing Conditions.

1. Coordination of excavation of trenches and the installation of piping on site.

C. Division 03: Concrete.

1. All concrete work for Fire Suppression Division shall be included in Division 21 under the appropriate Sections and shall include:

a. Concrete curbs and housekeeping pads for the equipment.

b. Thrust blocks for piping.

D. Division 07: Thermal and Moisture Protection.

1. Sealants and caulking.

2. Firestopping.

E. Division 09: Finishes:

1. Division 21 installers shall perform all painting, except where specifically stated otherwise in Division 09.

F. Division 26: Electrical is related to work of:

1. Fire protection alarms and relays.

2. Detectors and monitoring.

3. Power connections to all equipment.

4. Life safety provisions.

1.7 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Perform all tests required by governing authorities and required under all Division 21 Sections. Provide written reports on all tests.

C. Electrical devices and wiring shall conform to the latest standards of NEC; all devices shall be UL listed and labeled.

D. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

E. Provide in accordance with rules and regulations of the following.

1. NFPA Standards:

   a. NFPA 13: Standard for Installation of Sprinkler Systems (Latest adopted version)

   b. NFPA 24: Standard for the Installation of Private Fire Service Mains and Their Appurtenances (Latest adopted version)

   c. NFPA 25: Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems (Latest adopted version)

   d. NFPA 70: National Electrical Code (latest adopted version)

   e. NFPA 101: Life Safety Code (Latest adopted version)

2. Building Codes enforced by the Authority Having Jurisdiction in Oregon:

   a. 2014 Oregon Structural Specialty Code (OSSC) based on 2012 International Building Code (IBC)

   b. 2014 Oregon Energy Efficiency Code (OEESC) based on the 2009 International Energy Conservation Code (IECC)

   c. 2014 Oregon Mechanical Specialty Code (OMSC) based on 2012 International Mechanical Code (IMC) and 2012 International Fuel Gas Code (IFGC) with State Amendments

   d. 2014 Oregon Plumbing Code (OPC) based on 2009 Uniform Plumbing Code (UPC) with State Amendments

   e. 2014 Oregon Fire Code (Based on the 2012 International Fire Code)

   f. 2014 Oregon Electric Specialty Code (Based on the 2014 National Electric Code (NEC) with State Amendments

3. Local, city, county and state codes and ordinances

4. Local and State Fire Prevention Districts.

5. University of Oregon Construction Standards-Latest Edition.

6. Other applicable standards and references:

   a. UL and FM Compliance: Provide products, which are UL listed and FM approved.

   b. ASCE/SEI 7-10: Minimum Design Loads for Buildings and Other Structures.

   c. MSS Standard Compliance: Manufacturer's Standardization Society (MSS).

d. SMACNA: Seismic Restraint Manual-Guidelines for Mechanical Systems.

e. Factory Mutual Approval Guide (Product listing, only).

f. Factory Mutual Approval Guide and FM Pamphlet #20 “Rules for Installing Sprinklers” (Product listing and project review).

g. Underwriters Laboratories, Inc.

h. Industrial Risk Insurance Underwriters.

i. Owner’s insurance agency.

F. Provide in accordance with appropriate referenced standards of the following:

1. NFPA - National Fire Protection Association.

2. CSA - Canadian Standards Association.

3. ANSI - American National Standards Institute.

4. ASME - American Society of Mechanical Engineers.

5. ASTM - American Society for Testing Materials.

6. AWS - American Welding Society.

7. AWWA - American Water Works Association.

8. FM - Factory Mutual.

9. MSS - Manufacturer's Standardization Society.

10. NEMA - National Electrical Manufacturer's Association.

11. UL - Underwriter's Laboratories.

12. ADA - Americans with Disabilities Act.

13. ETL - Electrical Testing Laboratories.

14. IAPMO - International Association of Plumbing and Mechanical Officials.

1.8 QUALITY ASSURANCE

A. Manufacturer's Nameplates: Nameplates on manufactured items shall be aluminum or Type 304 stainless steel sheet, not less than 20 USG (0.0375”), riveted or bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of equipment data.

B. Current Models. All work shall be as follows:

1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.

2. Replacement parts shall be readily available and stocked in the USA.

C. Experience: Unless more stringent requirements are specified in other sections of Division 21, manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than one year prior to the date of bidding for this project.

D. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data

1. Upon request, the Owner's Representative shall be furnished certification by the manufacturer, stating samples representing each lot have been tested and inspected as indicated in governing ASTM specifications have been met. Certification shall be accompanied by test reports as prepared in accordance with relevant ASTM sections governing Test Methods and Inspection. Tension Tests reports shall include breaking load, machined diameter of the test bars, and calculated tensile strength. Certification shall include the legal name and address of the manufacturer.

1.9 GENERAL REQUIREMENTS

A. Examine all existing conditions at building site.

B. Review contract documents and technical specifications for extent of new work to be provided.

C. Provide and pay for all permits, licenses, fees and inspections.

D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for mechanical access.

E. Coordinate equipment and materials installation with other building components.

F. Verify all dimensions by field measurements.

G. Arrange for chases, slots, and openings in other building components to allow for installations.

H. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

I. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the work.

J. Coordinate the cutting and patching of building components to accommodate the installation of equipment and materials. Contractor to provide for all cutting and patching required for installation of his work unless otherwise noted.

K. Install fire protection services and overhead equipment to provide the maximum headroom possible.

L. Install equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations.

M. Coordinate the installation of materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, and other installations.

N. Coordinate connection of systems with exterior underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

O. Coordinate with Owner's Representative in advance to schedule shutdown of existing systems to make new connections. Provide valves in new piping to allow existing system to be put back in service with minimum down time.

P. All materials (such as insulation, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

Q. Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this Division. Any such products installed as part of the work of the Division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor.

1.10 MINOR DEVIATIONS

A. The Contractor shall review the structural and architectural conditions and drawings affecting his work. It is the specific intention of this section that the contractor's scope of work shall include

1. Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications

B. The Contractor shall study the operational requirements of each system, and shall arrange his work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the proper and efficient installation of all systems from the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the "Electrical Work." Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labor and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

C. Advice the Owner's Representative, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner's Representative of conflict.

1.11 PRODUCT SUBSTITUTIONS

A. The Contractor shall certify the following items are correct when using substituted products other than those scheduled or shown on the drawings as a basis of design:

1. The proposed substitution does not affect dimensions shown on drawings.

2. The Contractor shall pay for changes to building design, including engineering design, detailing, structural supports, and construction costs caused by proposed substitution.

3. The proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.

4. Maintenance and service parts available locally are readily obtainable for the proposed substitute.

B. The Contractor further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item.

C. The Contractor agrees that the terms and conditions for the substituted product that are found in the contract documents apply to this proposed substitution.

1.12 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with Division 01 requirements.

B. After approval of preliminary list of materials, the Contractor shall submit Shop Drawings and manufacturer's Certified Drawings to the Owner's Representative for approval.

C. The Contractor shall submit approved Shop Drawings and manufacturer's equipment cuts, of all equipment requiring connection by Division 26, to the Electrical Contractor for final coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate with Division 26.

D. Submittals and Shop Drawings:

1. Submit electronic copies of manufacturer's submittal sheets in one (1) coordinated package per Division. Multiple submissions will not be accepted without prior approval of the Owner's Representative. Organize submittal sheets in sequential order aligned with matching specification section numbers.

2. Provide electronic copies of shop drawings prepared to show details of the proposed installation. Copies of contract design drawings submitted to demonstrate shop drawing compliance will not be accepted.

3. Paper submittals will only be acceptable if specifically required by Division 01.

4. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Refer to Division 01 for additional requirements.

1.13 COORDINATION DOCUMENTS/SHOP DRAWINGS

A. The Contractor shall prepare coordinated Shop Drawings using the same electronic format as the contract documents.

1. The shop drawings shall serve to record the coordination of the installation and location of all fire sprinkler heads, piping, HVAC equipment, ductwork, grilles, diffusers, lights, audio/video systems, electrical services and all system appurtenances.

2. The Drawings shall include all mechanical rooms and floor plans.

3. The Drawings shall be keyed to the structural column identification system, and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Owner's Representative and the structural requirements, and all other trades (including HVAC, Plumbing, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances. When conflicts are identified, modify system layout as necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor and Owner's Representative.

4. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings or electronic coordination should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

B. The coordination work shall be prepared as follows:

1. Two dimensional AutoCAD / Revit based documents:

a. Contractor shall prepare AutoCAD/Revit coordination drawings to an accurate scale of 1/4" = 1'-0" or larger. Drawings are to be same size as Contract Drawings and shall indicate locations, sizes and elevations above finished floor, of all systems. Lettering shall be minimum 1/8" high.

b. Contractor shall obtain AutoCAD/Revit drawings from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the HVAC work.

c. Fire protection drawings shall indicate locations of all sprinkler heads and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.

d. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.

e. Drawings shall incorporate all addenda items and change orders.

f. Distribute drawings to all other trades and provide additional coordination as needed to assure adequate space for piping, equipment and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

C. Advise the Owner's Representative in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner's Representative of conflict.

D. Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Owner's Representative of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

E. Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

1.14 REQUESTS FOR INFORMATION (RFIS)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified (refer to Division 01).

1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

2. RFIs shall address single questions and related issues only.

3. All RFIs shall be thoroughly reviewed and approved by the General Contractor and/or Construction Manager for accuracy and need for information required before submittal to the Owner's Design Representative.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.

2. Project number.

3. Date.

4. Name of Contractor.

5. Name of Architect and Construction Manager.

6. RFI number, numbered sequentially and unique.

7. RFI subject.

8. Specification Section number and title and related paragraphs, as appropriate.

9. Drawing number and detail references, as appropriate.

10. Field dimensions and conditions, as appropriate.

11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

12. Contractor's signature.

13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer’s Action: Engineer will review each RFI, determine action required, and respond. Allow a minimum three business days for Engineer's response for each RFI, plus additional time for Architect and General Contractor to review and forward. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Incomplete RFIs or inaccurately prepared RFIs.

    b. RFIs submitted without indication of review and approval for submission by General Contractor or Construction Manager.

    c. RFIs addressing multiple unrelated issues.

    d. Requests for approval of submittals.

    e. Requests for approval of substitutions.

    f. Requests for approval of Contractor's means and methods.

    g. Requests for information already indicated in the Contract Documents.

    h. Requests for adjustments in the Contract Time or the Contract Sum.

    i. Requests for interpretation of Engineer's actions on submittals.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

1.15 RECORD DOCUMENTS

A. Maintain set of Coordination Documents (drawings and specifications) marked “Record Set” at the job site at all times, and use it for no other purpose but to record on it all the changes and revisions during construction.

B. Record Drawings shall indicate revisions to piping, size and location both exterior and interior; including control devices, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance.

C. Record Specifications shall indicate approved substitutions; Change Orders; and actual equipment and materials provided.

D. At the completion of the construction transfer all “Record Set” notations to a clean set of drawings and specifications in a neat and orderly fashion that incorporates all site markups to clearly show all changes and revisions to the Contract Documents. Submit copies of Record Documents and CD/DVD disks labeled with all drawings and specifications and other supporting documentation.

E. Refer also to Division 01 for full scope of requirements.

1.16 START-UP SERVICE AND BUILDING COMMISSIONING

A. Prior to start-up, be assured that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

B. Provide services of factory-trained technicians for start-up of pumps, and other major pieces of equipment. Certify in writing compliance with this Paragraph, stating names of personnel involved and the date work was performed.

C. Refer to other Division 21 Sections for additional requirements.

1.17 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. O&M Manuals: Upon completion of the work, the Contractor shall submit to the Owner’s Representative complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section, bound in a durable binder. Refer to Division 01.

B. The Contractor shall be responsible for proper instruction of Owner's personnel for operation and maintenance of equipment, and apparatus installed as specified in Division 21 to be no less than 2 hours for each piece of equipment.

1.18 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping and equipment showing signs of rust shall be removed from site and replaced with new.

1.19 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.20 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal hours of work.

B. No act, service, Drawing, review, or Construction Review by the Owner, Architect, the Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify and defend the Owner, the Architect, the Engineers and their consultants, and each of their officers, employees and agents from any and all liability claim, losses or damage arising, or alleged to arise from bodily injury, sickness, or death of a person or persons, and for all damages arising out of injury to or destruction of property arising directly or indirectly out of, or in connection with, the performance of the work under the Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the Construction Contract Documents; but not including the sole negligence of the Owner, the Architect, the Engineers, and their consultants or their officers, employees and agents.

1.21 CLEANING AND CLOSING

A. All work shall be inspected, tested, and approved before being concealed or placed in operation.

B. Upon completion of the work, all equipment installed as specified in this section, and all areas where work was performed, shall be cleaned to provide operating conditions satisfactory to the Owner’s Representative.

1.22 WARRANTIES

A. Refer to general terms and conditions, as well as warranties and obligations defined in Division 1 of the specifications that provide basic warranty requirements for the entire project.

B. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.

C. All equipment and systems shall be provided with a minimum one-year warranty, defined as starting from the date of Certificate of Occupancy, and shall include all parts, material, labor and travel.

D. Refer to individual Specification sections for additional extended warranty requirements.

E. Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

F. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

G. Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period.

1.23 GUARANTEE

A. The Contractor shall guarantee and service all workmanship and materials to be as represented by him and shall repair or replace, at no additional cost to the Owner, any part thereof which may become defective within the period of one (1) year, minimum, after the Certificate of Occupancy, ordinary wear and tear excepted. The guarantee shall include parts, shipping, labor, travel costs, living expenses, required fees, and any other associated cost or expense to repair or replace products or systems

B. Contractor shall be responsible for and pay for any damages caused by or resulting from defects in this work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

B. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be considered to be subsequent to all manufacturers' names used herein, unless specifically noted that substitutes are not allowed.

2.2 SUPPORTS AND ANCHORS

A. General: Comply with applicable codes pertaining to product materials and installation of supports and anchors, including, but not limited to, the following:

1. Provide copper plated or plastic coated supports and attachment for copper piping systems. Field applied coatings or tape is unacceptable.

2. Manufacturers: Hilti Inc., B-Line, Anvil International, Tolco, Kin-Line, Simpson, Erico or Superstrut.

B. Horizontal Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated hangers and supports of one of the following MSS types listed.

1. Adjustable Steel Clevis Hangers: MSS Type 1.

2. Adjustable Steel Swivel Band Hangers: MSS Type 10.

3. U-Bolts: MSS Type 24.

4. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:

a. Plate: Unguided type.

b. Plate: Guided type.

c. Plate: Hold-down clamp type.

5. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast iron floor flange.

6. Pipe Saddle Supports with U-Bolt: MSS Type 37, including steel pipe base support and cast iron floor flange.

7. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast iron floor flange.

8. Single Pipe Roller with Malleable Sockets: MSS Type 41.

9. Adjustable Roller Hangers: MSS Type 43.

10. Pipe Roll Stands: MSS Type 44.

11. Pipe Guides: Provide factory-fabricated guides of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if

any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

C. Horizontal Cushioned Pipe Clamp: Where pipe hangers are called out to absorb vibration or shock install a piping clamp with thermoplastic elastomer insert. Cush-A-Clamp or equal.

D. Vertical Piping Clamps: Provide factory-fabricated two-bolt vertical piping riser clamps, MSS Type 8.

E. Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of one of the following MSS types listed.

1. Steel Turnbuckles: MSS Type 13.

2. Steel Clevises: MSS Type 14.

3. Swivel Turnbuckles: MSS Type 15.

4. Malleable Iron Eye Sockets: MSS Type 16.

5. Steel Weldless Eye Nuts: MSS Type 17.

F. Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments of one of the following types listed.

1. Concrete Inserts: HCI-MD (for metal deck) or HCI-WF (for wood forms) cast-in anchors by Hilti Inc. or MSS Type 18 or Blue Banger Hanger by Simpson

2. Steel Brackets: One of the following for indicated loading:

a. Light Duty: MSS Type 31.

b. Medium Duty: MSS Type 32.

c. Heavy Duty: MSS Type 33.

3. Horizontal Travelers: MSS Type 58.

4. Concrete Screw Anchors: Hilti Kwik HUS EZ or equal.

5. Torque-Controlled Expansion Anchor: Hilti Kwik Bolt TZ or equal.

G. Saddles and Shields (for heat traced pipe): Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation

1. Pipe Covering Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

2. Insulation Protection Shields: MSS Type 40, 18” minimum, or of the length recommended by manufacturer to prevent crushing of insulation. High-density insulation insert lengths shall match or exceed shield length.

3. Thermal Hanger Shields: Constructed of 360° insert of waterproofed calcium silicate (60 psi flexural strength minimum) encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation. Shield length shall match or exceed length of calcium silicate insert.

4. Thermal Hanger Couplings: Constructed of high strength plastic coupling to retain tubing and join insulation at clevis hangers and strut-mounted clamps. Klo-Shure Insulation Coupling or equal.

H. Miscellaneous Materials:

1. Metal Framing: Provide products complying with NEMA STD ML1.

2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A36.

3. Cement Grout: Portland Cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand by volume, with minimum amount of water required for placement and hydration.

4. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required. Weld steel in accordance with AWS standards.

5. Pipe Brackets: "HoldRite" copper plated brackets. Insulate brackets attached to metal studs with felt.

2.3 SEISMIC RESTRAINT/ REQUIREMENTS

A. Equipment, piping, and all system appurtenances (including weight of normal operating contents) shall be adequately restrained to resist seismic forces. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest code editions with State Amendments, applicable local codes, and applicable Importance Factors and Soil Factors. Refer to Section 210548 Vibration Isolation for Fire Protection Equipment or Section 210549 Seismic Restraint for Fire Protection Piping and Equipment, as applicable.

2.4 ACCESS PANELS AND ACCESS DOORS

A. Provide all access doors and panels to serve equipment under this work, including those which must be installed, in finished architectural surfaces. Frame of 16-gauge steel, door of 20 gauge steel. 1” flange width, continuous piano hinge, key operated, prime coated. Refer to Architectural Specifications for the required product Specification for each surface. Contractor is to submit schedule of access panels for approval. Exact size, number and location of access panels are not shown on Plans. Access doors shall be of a size to permit removal of equipment for servicing. Access door shall have same rating as the wall or ceiling in which it is mounted. Provide access panel for each concealed valve. Use no panel smaller than 12" x 12” for simple manual access, or

smaller than 24" x 24" where personnel must pass through. Provide cylinder lock for access door serving mixing or critical valves in public areas.

B. Included under this work is the responsibility for verifying the exact location and type of each access panel or door required to serve equipment under this work and in the proper sequence to keep in tune with construction and with prior approval of the Owner's Representative. Access doors in fire rated partitions and ceilings shall carry all label ratings as required to maintain the rating of the rated assembly.

C. Acceptable Manufacturers: Milcor, Karp, Nystrom, Elmdor/Stoneman, or equal.

D. Submit markup of architectural plans showing size and location of access panels required for equipment access for approval by Owner's Representative.

2.5 IDENTIFICATION MARKERS

A. Valve Tags:

1. Brass Valve Tags: Provide 1 1/2" diameter 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener. Fill tag engraving with black enamel.

2. Plastic Laminate Valve Tags: Provide 3/32" thick engraved plastic laminate valve tags, with piping system abbreviations in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32" hole for fasteners.

3. Valve Tag Fasteners: Provide solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

4. Access Panel Markers: Provide 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.6 ELECTRICAL

A. General:

1. All electrical material, equipment, and apparatus specified herein shall conform to the requirements of Division 26.

2. Provide all motors for equipment specified herein. Provide motor starters, controllers, transfer switches, and other electrical apparatus and wiring which are required for the operation of the equipment specified herein.

3. Provide expanded metal or solid sheet metal guards on all V-belt drives to totally enclose the drive on all sides. Provide holes for tachometer readings. Support guards separately from rotating equipment.

4. Provide for all rotating shafts, couplings, etc., a solid sheet metal, inverted "U" cover over the entire length of the exposed shaft and support separately from rotating equipment. Cover shall extend to below the bottom of the shaft and coupling, and shall meet the requirements of the State Industrial Safety Regulations.

5. Specific electrical requirements (i.e., horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.

B. Quality Assurance:

1. Electrical components and materials shall be UL or ETL listed/labeled as suitable for location and use - no exceptions.

C. Low Voltage Control Wiring:

1. General: 14 gauge, Type THHN, color coded, installed in conduit.

2. Manufacturer: General Cable Corp., Alcan Cable, American Insulated Wire Corp., Senator Wire and Cable Co., Southwire Co, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship shall be performed by licensed journeymen or master fitter and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal, or otherwise irregular work, unless so indicated on Drawings or approved by Owner’s Representative.

3.2 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

3.3 INSTALLATION

A. Coordinate the work between the various Fire Protection Sections and with the work specified under other Divisions. If any cooperative work must be altered due to lack of proper supervision or failure to make proper and timely provisions, the alternations shall be made to the satisfaction of the Owner’s Representative and at the Contractor’s cost. Coordinate wall and ceiling work with the General Contractor, and his subcontractors in locating ceiling air outlets, wall registers, etc.

B. Inspect all material, equipment, and apparatus upon delivery and do not install any damaged or defected materials.

C. Penetrations through acoustically significant construction shall be sealed airtight in accordance with Resiliently Sealed Penetration Details and Section 079219 – Acoustical Joint Sealants. Escutcheons shall not be used at acoustically significant penetrations so that resilient seals can be observed."

3.4 SUPPORTS AND HANGERS

A. Installation of Building Attachments: Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed. Fasten insert securely to forms.

B. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors, and other building structural attachments.

C. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

E. Support sprinkler piping independently of other piping.

F. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

G. Sloping, Air Venting, and Draining:

1. Slope all piping as specified and as indicated, true to line and grade, and free of traps and air pockets. Unless indicated otherwise, slope piping in the direction of flow as follows:

Service	Slope
Wet	Not required
Dry Mains	1/4"/10'
Dry Branches	1/2"/10'

H. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connecting equipment.

I. Installation of Anchors:

1. Install anchors at proper locations to prevent excessive stresses and to prevent transfer of loading and stresses to connected equipment.

2. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure.

3. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

4. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends.

J. Equipment Supports:

1. Provide all concrete bases, unless otherwise furnished as work of Division 03. Furnish to Division 03 Contractor scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories necessary for base construction.

2. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks.

K. Adjusting:

1. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

2. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

3. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 PIPE PORTALS

A. Install per manufacturer's instructions.

B. Coordinate with other trades they are installed when roofing is being installed.

3.6 ELECTRICAL COORDINATION

A. Division 21 installers shall coordinate with Division 26 work to provide complete systems as required to operate all mechanical devices installed under this Division of work. Escutcheons shall not be used at acoustically significant penetrations so that resilient seals can be observed.

B. Installation of Electrical Connections: Furnish, install, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, etc., motors and controls in accordance with the drawings and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA's "Standard of Installation" to ensure that products fulfill requirements.

C. Division 21 has responsibilities for electrically powered fire protection equipment which is specified in Division 21 Specifications or scheduled on Division 21 Drawings as follows:

1. Motors: Furnish and install all motors necessary for mechanical equipment.

2. Magnetic Starters: Furnish all magnetic starters whether manually or automatically controlled which are necessary for mechanical equipment. Furnish these starters with all control relays or transformers necessary to interface with mechanical controls. If the starter is factory installed on a piece of Division 21 equipment, also furnish and install the power wiring between starter and motor.

3. Controls: Division 21 Contractor (including the Building Automation System (BAS) Controls subcontractor) is responsible for furnishing the following equipment in its entirety. This equipment includes but is not limited to the following:

a. Control relays necessary for controlling Division 21 equipment.

b. Control transformers necessary for providing power to controls for Division 21 equipment.

c. Low or non-load voltage control components.

d. Non-life safety related valve or damper actuators.

e. Solenoid valves, EP and PE switches.

f. Communications wiring and conduit between control devices and fire protection equipment.

g. Raceway to support control cabling.

D. Division 26 Electrical Responsibilities:

1. Disconnects: Provide all disconnects necessary for Division 21 fire protection equipment which are not provided as part of factory wired Division 21 equipment. Provide power wiring to all disconnects. In addition, provide power wiring between motor and disconnect when the disconnect is not factory installed.

2. Controls: Division 26 is responsible for providing power to control panels and provide final power connection to Division 21 provided control transformers.

3. Fire Sprinkler System: Division 26 is responsible for providing power wiring to fire protection controls including flow switches and alarm bells.

3.7 TESTING

A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Owner's Representative, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

END OF SECTION

SEISMIC RESTRAINT FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 210500 - Basic Fire Protection Materials and Methods, and other Sections in Division 21 specified herein.

1.2 SUMMARY

A. This Section includes the following:

1. Seismic restraint and support of piping and fire protection equipment as required by code and as designed by project registered professional Structural Engineer.

2. Mechanical component supports and the means by which that are attached to the fire protection component shall be designed for the forces and displacements determined in ASCI 7-10 Section 13.3.1 and 13.3.2. Such supports include structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as a part of the mechanical component.

3. Support and seismic bracing for sprinkler piping shall comply with requirements of NFPA 13 – Standard for Installation of Sprinkler Systems.

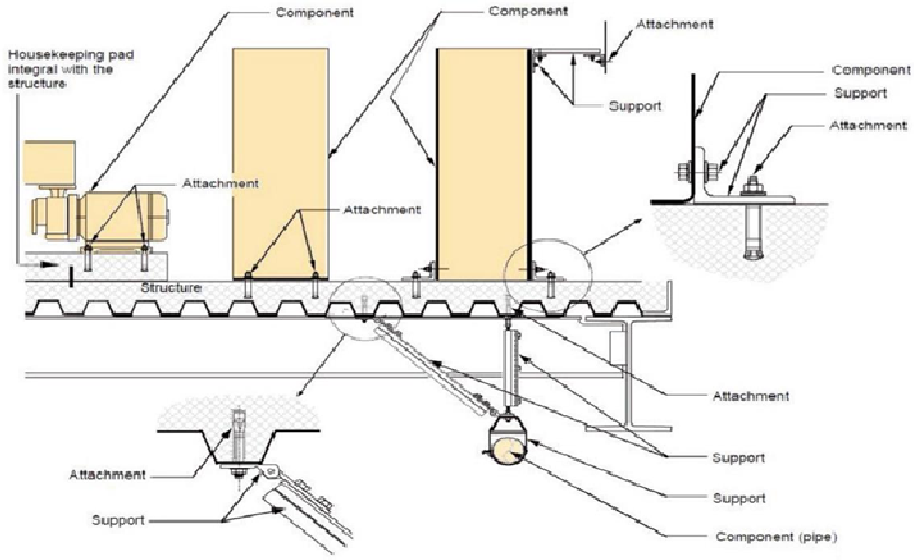
1.3 DEFINITIONS

A. AHJ: Authority Having Jurisdiction

B. IBC: International Building Code with AHJ Amendments.

C. ICC-ES: ICC-Evaluation Service.

D. Fire Protection Components: Examples of attachments and supports for a variety of mechanical components are shown as follows:



E. Fire Protection Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachments to the structure.

F. Fire Protection Attachments: Means by which components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Section 210500: Basic Fire Protection Materials and Methods

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide systems that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Structural Performance: Restraint devices and systems shall withstand the effects of locally defined gravity loads, seismic loads, dead loads, live loads, winds loads and stresses within limits and under conditions indicated according to the Building Code and ASCE 7. Coordinate all support structures and restraint systems with project registered professional Structural Engineer.

C. Codes and Standards: Provide components conforming to the seismic load requirements of the latest addition of the local building code and the following:

1. International Building Code with State Amendments

a. Section 1613: Standard Occupancies
b. Section 1616: Schools (DSA-SS or DSA-SS/CC Projects in California)

c. Section 1616A: Healthcare (OSHPD and DSA-SS Projects in California)

2. NFPA-13: Standard for the Installation of Sprinkler Systems

3. American Society of Civil Engineers (ASCE):

a. ASCE 7-10 - Minimum Design Loads for Buildings and Other Structures

4. Cooper B-Line/Tolco: Supports and Attachments of Non-Structural Fire Protection Systems

5. Erico International: Seismic Sway Bracing for Fire Sprinkler

1.6 SUBMITTALS

A. Product Data:

1. Include rated load, rated deflection, and overload capacity for each device or system.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service or agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Submit seismic brace product details detailing compliance with the specifications.

4. Where products from pre-approved manufacturers cannot be used, special details must be submitted for approval.

B. Seismic Restraint Calculations

1. Where seismic restraint sizes, spacing and anchorage are included in the Mason West Seismic Guidelines no further calculations are required.

2. Where additional information is required:

a. Seismic restraint calculations must be provided for all connections to the structure.
b. Calculations must be stamped and signed by a registered professional Structural Engineer.

1.7 ENGINEERED PIPING SYSTEMS

A. Where the piping system design indicated on the plans utilizes OSHPD pre-approved seismic restraint components and flexible connectors the following requirements apply:

1. Pre-approved products must be installed as shown.

2. If product substitutions or design changes are made the contractor must provide certified design of the piping system and meet the following conditions:

a. Certification must be provided by a registered professional Structural Engineer.
b. Certification shall include a statement that all systems have been checked for loads and stresses and that no excessive loads or stresses exist.
c. Forces on all anchors, guides, supports, and restraints must not exceed those shown in the original design unless the structure is checked for the larger loads at no cost to the owner.

B. Where the piping system design is not indicated on the drawings the design is delegated to the contractor with the following requirements for piping certification and analysis:

1. The supports, anchors, seismic braces for fire protection systems.

2. The results of the analysis shall include reactions at restraints and anchors, maximum pipe displacements and a code compliant report indicating maximum pipe stresses.

3. Where required, seismic restraint components, anchors, expansion compensators and flexible connectors shall be incorporated into the design of the systems.

4. The analysis and design must be performed by a Structural Engineer with 5 years of experience in this field.

1.8 MANUFACTURER AND CONTRACTOR RESPONSIBILITIES

A. All seismic restraints shall be designed by a registered professional Structural Engineer.

B. Seismic restraint layouts for piping shall be added to the contractor's shop drawings and shall include:

1. The number, size and location of seismic braces.

2. Maximum support loads and seismic loads at the seismic brace locations.

3. Reference to specific details or pages from OSHPD pre-approval OPM guidelines.

C. Installations not addressed by the OPM approval must be designed, detailed and submitted along with the shop drawings.

D. Submit seismic restraint layout drawings and special details for approval of the project registered professional Structural Engineer.

E. Seismic restraint layout drawings shall bear the stamp and signature of the registered professional Structural Engineer who designed the layout of the braces.

1.9 LOADS ON STRUCTURE

A. The responsibility of determining allowable loads on the structure is the sole responsibility of the project registered professional Structural Engineer.

B. Maximum support loads and seismic brace loads on the structure must be less than the maximum allowable loads defined by the project registered professional Structural Engineer, as shown on the plans.

C. Where maximum loads are not listed on the plans or the maximum allowable loads cannot be met, any additional support steel required to reduce support and seismic bracing loads on the structure shall be designed by the project registered professional Structural Engineer.

D. Mechanical component supports and the means by which that are attached to the component shall be designed for the forces and displacements determined in ASCI 7-10 Section 13.3.1 and 13.3.2. Such supports include structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as a part of the fire protection component.

E. Mechanical supports are those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachments to the structure.

F. Mechanical attachments are the means by which components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

PART 2 - PRODUCTS

2.1 INTENT

A. All seismic restraints described in this section shall be the product of a single manufacturer.

B. Cooper B-Line/Tolco and Erico products are the basis of these specifications; products of other manufacturers may be submitted for review provided their systems strictly comply with the specifications.

2.2 SEISMIC SWAY BRACING

A. Seismic sway braces shall consist of galvanized steel aircraft cables, steel angles or steel struts.

B. Cables braces shall be designed to resist seismic tension loads and steel braces shall be designed to resist both tension and compression loads. Brace end connections shall be steel assemblies that swivel to the final installation angle.

C. Cable brace assemblies shall have published strength and stiffness ratings based on testing per FM-1950 standards.

D. Angle or strut bracket assemblies shall be FM Approved except as noted below.

E. Steel angles or struts, when required, shall be clamped to the threaded hanger rods at the seismic sway brace locations utilizing a minimum of two ductile iron clamps.

F. Cable brace bracket assemblies shall be Type SCB or SCBH. Solid brace bracket assemblies shall be Type SSB-FM, SSBS-FM or SHB-FM. All bracket assemblies shall have published strength and stiffness values based on testing per FM-1950.

G. Rod clamps shall be Type SRC or UCC.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor's Statement of Responsibility: Each contractor responsible for installing a Designated Seismic System or any seismic resisting component must submit a statement of responsibility prior to the commencement of work to include acknowledgment of awareness of the need for special inspections contained in the statement of special inspections.

B. All seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.

C. Piping Restraints:

1. Space lateral supports a maximum of 40 feet (12 m) on center.

2. Space longitudinal supports a maximum of 80 feet (24.4 m) and provide for feed and cross mains.

3. Brace a change of direction longer than 12 feet (3.7m).

D. No connections between the piping and the building structure shall be made that degrades the seismic restraint system herein specified.

E. Any conflicts with other trades due to inadequate space or other unforeseen conditions should be brought to the attention of the Owner's Representative prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

F. Installation of seismic restraints must not cause any change of position of equipment or piping resulting in stresses or misalignment.

G. Install seismic-restraint devices using methods approved by an evaluation service or agency acceptable to the authorities having jurisdiction, providing required submittals for component.

3.2 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

END OF SECTION

COMMISSIONING OF FIRE SUPPRESSION

PART 1 - GENERAL

1.1 COMMISSIONING AUTHORITY

A. The commissioning authority (CxA) has been contracted directly with the owner for this project. The CxA has overall responsibility for planning and coordinating the commissioning process. However, commissioning involves all parties involved with the design and construction process, including the Fire Suppression (Division 22) contractor, and all specialty subcontractors within Division 21, plus major equipment suppliers as required.

1.2 CONTRACTOR RESPONSIBILITY

A. The Fire Suppression (Division 21) contractor's responsibilities are defined in Section 01 91 13, "Commissioning Requirements" of the specifications. These responsibilities apply to all specialty subcontractors and major equipment suppliers within Division 21. Each subcontractor and supplier shall review Section 01 9113, and their bids shall include for carrying out the work described, as it applies to each section within the Division 21 specifications, individually and collectively.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

FIRE PROTECTION

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 210500 - Basic Fire Protection Materials and Methods, and other Sections in Division 21 specified herein.

1.2 DEFINITIONS

A. Pipe sizes used in this Section are nominal pipe size (NPS) specified in inches.

B. Working plans as used in this Section refer to documents (including drawings and calculations) prepared pursuant to requirements in NFPA 13 for obtaining approval of authority having jurisdiction.

C. NICET - National Institute For Certification In Engineering Technologies

D. Other definitions for fire protection systems are included in referenced NFPA standards.

1.3 DESCRIPTION OF WORK

A. The work includes designing, providing and installing two complete and fully operable automatic sprinkler system as described in this Section of the Specification and as shown on the contract construction drawings and shall be in accordance with rules, regulations and standards as required by the authorities having jurisdiction.

1. State of Oregon.

2. Lane County.

3. Building Department.

4. Fire Prevention Division, Fire Marshal’s Office.

5. University of Oregon Construction Standards-Latest Edition.

B. Work includes but is not limited to the following:

1. Automatic Wet Type Sprinkler System.

2. Areas Subject to Freezing Temperatures: Dry Type Sprinkler System.

3. Remodeling of existing systems.

4. All cutting and patching.

5. Provide all pipe, fittings, sprinklers, valves, signs, flow switches, tamper switches, protective painting, test connections, drains and tests necessary to make the entire system complete and operative.

6. Coordinate with plumbing contractor for capacity of all sprinkler main, test, and auxiliary drain connections.

7. Valve tags and instruction plates shall be mounted and/or hung per local fire department requirements.

8. All sleeves and inserts.

9. 2" drain riser shall be provided adjacent to each sprinkler valve assembly for testing and draining.

10. All trenching and backfilling, including culverts under rails and guard posts where required.

1.4 SUBMITTALS

A. Product Data: Submit six copies of manufacturer's technical data and installation instructions for fire protection materials and products.

1. Thirty days after the awarding of contract, contractor shall submit list of manufacturer's names and model numbers for review and comment to Owner's Representative. This list shall identify any prior approved substituted items contractor wishes to use. Do not submit technical data until list has been approved.

2. Prior to construction submit for review and comment items including but not be limited to the following:

a. Coordinated layout drawings. Lettering shall be minimum 1/8" high.
b. Sprinklers and escutcheons - designating area of use.
c. Valves, valve boxes, flow switches, and tamper switches.
d. Provide Fire Marshal approval numbers for flow switches and tamper switches.
e. Pipe, fittings, sway bracing, inserts, anchors and hangers.
f. Inspector's test and drain station.
g. Fire department connections.

B. Working Plans: Prepare scaled working plans for fire protection pipe and fittings including, but not necessarily limited to, pipe and tube sizes, locations, and elevations and slopes of horizontal runs, wall and floor penetrations, and connections. Indicate interface between and spatial relationship to piping and adjacent equipment. Lettering shall be minimum 1/8" high.

1. Spacing of fire sprinklers shall be coordinated with lights, air conditioning outlets, sound speakers, architectural reflected ceiling plan; obstruction from light fixtures and other architectural features; and sprinkler piping shall be coordinated with HVAC ductwork & piping, plumbing, electrical conduit, cable trays and structure prior to the installation.

Drawings shall be composite type including mechanical, plumbing and lighting equipment with sprinkler and sprinkler drain piping.

C. Submittal Drawings: Submit shop drawings to Agency having jurisdiction for approval bearing engineer of record stamp bearing preparer's NICET stamp. Submit six approved copies, bearing stamp and/or signature of authority having jurisdiction to the Owner's Representative for review and comment.

1. Contractor shall submit sprinkler head locations to architect for approval.

2. Each calculation shall include legible schematic of system showing all hydraulic reference points.

D. Hydraulic Calculations: Prepare hydraulic calculations of fire protection systems. Submit to authority having jurisdiction for approval. Submit six approved copies, bearing stamp, and/or signature of Agency having jurisdiction to Owner's Representative for review and comment.

1. Contractor shall submit published piping friction loss data from manufacturer with hydraulic calculations.

E. Certificate of Installation: Submit certificate upon completion of fire protection piping work, which indicates that work has been tested in accordance with NFPA 13, and also that system is operational, complete, and has no defects.

F. Maintenance Data: Submit maintenance data and parts lists for fire protection materials and products. Include this data, product data, shop drawings, approval drawings, approval calculation, certificate of installation, and record drawings in maintenance manual; in accordance with requirements of the General Conditions and of Division 01.

G. Operating and Maintenance Instructions: Provide the Owner with three sets of operating and maintenance instructions covering completely the operation and maintenance of sprinkler equipment and controls. Manual shall be assembled in a 3-ring binder and arranged in following sections:

1. Site Utilities: Drawings showing location, size, depth of all connections, valve boxes, manholes, etc., as installed.

2. A chart tabulating all types of pipe fittings, valves, and piping specialties installed in each system.

3. A chart tabulating all pressures, valve settings for fire department and sprinkler pressure reducing valves. Provide pressure reducing valve flow test documentation.

4. Manufacturer's brochures of all sprinkler heads.

5. Tamper switches and flow switches.

6. Fire Department connections.

7. Reproducible copies of approved working drawings prepared to facilitate the actual installation of ductwork and piping. Drawings shall indicate location of all concealed valves, and other apparatus.

8. Copy of NFPA 25 "Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems."

9. Approval Calculations.

10. Certificate of Installation.

11. Guarantees.

12. The Contractor is responsible for proper instruction of Owner's personnel for operation and maintenance of all material, equipment and apparatus provided.

1.5 DESIGN DESCRIPTION

A. This section of the specification combined with any of the contract drawings are intended as a guide to establish a basis of design for the systems required.

B. Contractor shall examine the existing conditions, the Architectural, Interior Design, Structural, Mechanical and Electrical drawings, layout and install a completely hydraulically sized sprinkler system for all areas. Space shall be provided for any valving and equipment to be used.

1. System shall start at an existing connection in the Waterworks Building and extend throughout the Waterworks and Clubhouse buildings.

2. Contractor shall contact Owner’s insurance agency to incorporate insurer’s design requirements in this layout document.

C. All areas shall be sprinklered as the construction progresses, including accessible pipe chases, elevator hoistways, etc. Provide shutoff valve with tamper switch for elevator hoistways. Provide shutoff valve with tamper switch for elevator machine room.

D. All electrical devices used for this system shall be compatible with the fire alarm system, refer to Division 26.

1.6 HYDRAULIC DESIGN

A. System shall be a straight line or gridded system per NFPA No. 13 with the following exceptions:

1. For all systems the design area shall be the hydraulically most demanding rectangular area.

2. Minimum pressure for any sprinkler head shall not be less than 7 psi.

B. Total Combined Inside & Outside Hose Allowances: Hydraulic calculations shall include an allowance for hose streams, added at the point of connection to the water supply.

C. Safety Factor: 10 psi, or 10 percent of static and residual pressure, whichever is greater.

D. Sprinkler system Occupancy Hazard Classifications shall be approved by authorities having jurisdiction:

1. Building Service Areas: Ordinary Hazard, Group 1

2. Electrical Equipment Rooms: Ordinary Hazard, Group 1

3. General Storage Areas: Ordinary Hazard, Group 1

4. Mechanical Equipment Rooms: Ordinary Hazard, Group 1

5. Office and Public Areas: Light Hazard

6. Residential Living Areas: Light Hazard

7. Restaurant Service Areas: Ordinary Hazard, Group 1

E. Minimum Density for Automatic-Sprinkler Piping Design shall comply with the following:

1. Light Hazard Areas: Water density of 0.10 GPM per square foot calculated for an area of 1500 square feet in the most remote location.

2. Ordinary Group I Hazard Areas: Water density of 0.15 GPM per square foot calculated for an area of 1500 square feet in the most remote locations.

3. Ordinary Group II Hazard Areas: Water density of 0.20 GPM per square foot calculated for an area of 1500 square feet in the most remote locations.

F. Head spacing shall not exceed the limits described in NFPA Pamphlet No. 13.

1. Light Hazard: 225 sq.ft. (for smooth ceiling).

2. Ordinary Hazard: 130 sq. ft.

3. Extra Hazard: 100 sq. ft.

G. Maximum floor areas protected by any one sprinkler system riser:

1. Light Hazard: 52,000 sq.ft.

2. Ordinary Hazard: 52,000 sq.ft.

3. Extra Hazard: 40,000 sq. ft.

H. Flow Data: Contractor is to verify flow data (static pressure, residual pressure and GPM flowing) available at site and provide design for available pressure and flow.

1.7 RELATED WORK SPECIFIED ELSEWHERE

A. Section 210500: Basic Materials and Methods

B. Section 210549: Seismic Restraint for Fire Protection Piping and Equipment

C. Division 26: Electrical. Coordinate for electrical wiring of detectors, flow alarm switches, tamper switches, fire alarm bell, for electrical wiring of fuel oil and water tank level alarms, connection by life safety section for remote monitoring <<and starting>> of fire pump, and power to fire pumps. All electrical devices used for this system shall be compatible with the fire alarm system. Coordinate with electrical for electric fire pump motor size and emergency generator sizing.

D. Division 09: Finishes.

E. Division 02: Existing Conditions. Coordinate with General Contractor for excavation for the underground water supply system.

F. Division 22: Coordination with Plumbing for drain.

1.8 QUALITY ASSURANCE

A. The Contractor for the fire protection installation shall be duly qualified Fire Protection Contractor, experienced and regularly engaged in the installation of fire protection systems with a license classification of C-16. Where local authorities require additional licensing of the Fire Protection Contractor, and/or workmen, such a license shall be mandatory for a prospective Contractor.

1. Contractor is to verify flow data (static pressure, residual pressure and GPM flowing) available at site and provide design for available pressure and flow.

2. The Fire Protection contractor shall be the Engineer of Record for the automatic sprinkler and standpipe system.

3. Permits - The Fire Protection Contractor shall obtain permits for the installation or construction as required for approval and installation of the fire protection system. The Fire Protection Contractor shall submit working plans to the authorities having jurisdiction to obtain approval.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01. Handle components carefully to prevent damage, denting, and scoring. Do not install damaged components. Damaged components shall be replaced with new components.

B. Store/protect products under provisions of Division 01. Store components in clean, dry place. Protect from weather, dirt, water, construction debris, and physical damage.

1.10 WARRANTY – ADDITIONAL REQUIREMENTS

A. Refer to section 220500 for basic warranty requirements.

B. Contractor and Manufacturer warrant that, for a period of ten (10) years from the date of Certificate of Occupancy (or for such longer period as may be provided under the Contract or law), the entire system, including but not limited to the fittings and joints, will conform to the requirements of the Contract Documents, will be free from defects, and will not leak.

PART 2 - PRODUCTS

2.1 GENERAL

A. All products to be commercial grade, new and of the manufacturer's latest design model. Products manufacturers outside of North America will not be accepted without written approval from engineer prior to submission of bid.

B. All products to be UL listed and/or FM approved, except for items, which are not required to be listed by code.

C. All products shall be delivered and stored in original containers. Containers shall be clearly marked or stamped with manufacturer's name and rating.

D. The following items to be included but specified under Section 210500: Basic Fire Protection Materials and Methods.

1. Hangers and supports.

2. Escutcheons plates, flashings and sleeves.

3. Access panel and doors.

4. Identification markers and signs.

5. Expansion compensators and flexible connectors.

6. Anchors, and seismic restraints.

7. Excavation and backfill.

2.2 PIPE AND FITTINGS - ABOVE GROUND

A. General: The piping products listed below by manufacturer's name and model numbers are the only acceptable materials listed for this project. Substitutions of pipe must be submitted and approved in writing by the architect prior to bid. No copper pipe shall be allowed in the wet fire sprinkler system.

B. Piping or fittings that show substantial rust or breaks in coating will be removed and replaced.

C. Steel Pipe and Fittings for wet systems:

1. Standard-Weight, Galvanized- and Black-Steel Pipe: ASTM A53/A53M. Pipe ends may be factory or field formed to match joining method.

2. Schedule 40, Galvanized- and Black-Steel Pipe: ASTM A135/A135M; ASTM A795/A795M, or ASME B36.10M wrought steel, with wall thickness not less than Schedule 40. Pipe ends may be factory or field formed to match joining method.

3. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA-13 specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.

4. Galvanized- and Black-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.

5. Galvanized- and Uncoated-Steel Couplings: ASTM A865/A865M, threaded.

6. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

7. Malleable- or Ductile-Iron Unions: UL 860.

8. Cast-Iron Flanges: ASME 16.1, Class 125.

9. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

    a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
    b. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
    c. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
    d. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

10. Grooved-Joint, Steel-Pipe Appurtenances:

    a. Pressure Rating: 175-psig (1200-kPA) minimum, and as required by the design.
    b. Galvanized, Painted, or Uncoated Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
    c. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
    d. Mechanical Couplings: Victaulic grooved couplings style 07, 75 or 77, or equal by Gruvlok.
    e. Mechanical Tees: Victaulic style 920, Gruvlok. U-bolt mechanical tees are not acceptable.

f. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig (1200-kPa) pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
g. Use rigid couplings where flexibility is not required or provide necessary sway bracing.

D. Dry Standpipe, Dry Sprinkler Piping and Fittings:

1. Schedule 10 and 40 galvanized steel, ASTM A123.

2. Pipe ends may be factory or field formed to match joining method.

E. Flexible sprinkler connector for suspended ceiling sprinkler application: Flexhead or equal Factory Mutual approved system.

F. Piping and Fittings – Not Allowed:

1. Pipe less than Schedule 40 with threaded fittings is not allowed.

2. Schedule 5 piping and fittings are not allowed.

3. Threadable lightwall pipe is not allowed.

4. CPVC is not allowed.

5. Mechanical “gripping teeth” type fittings are not allowed.

6. Mechanical “clamping” type tee fittings are not allowed.

7. Quick disconnect, boltless, snap-joint, field drilling or welding of any main or branch lines, and any device specifically prohibited by the local authority having jurisdiction is not allowed.

8. Unions are not allowed for any size pipe.

9. Plain end fittings are not allowed.

2.3 PIPE AND FITTINGS - UNDERGROUND

A. Class 52 ductile iron pipe and fittings, white, cement lined, mechanical or Tyton joint fittings. Piping to be factory encased with 8 mil polyethylene tube or sheet. Fittings to be double field wrapped with 2" wide, 20 mil vinyl tape, 50% overlap.

B. Manufacturer: United States Pipe and Foundry, Griffin or Pacific States, only.

C. Polyvinyl Chloride (PVC) Plastic Pipe:

1. Pipe and fittings: Pipe shall conform to AWWA C900 and shall be plain end or gasket bell-end, pressure Class 150 with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron

or ductile-iron conforming to AWWA C110, and shall have cement lining conforming to AWWA C104, standard thickness.

2. Joints and Jointing Material: Joints for pipe shall be push on joints as specified in ASTM D3139. Joints between pipe and metal fittings, valves, and other accessories shall be push on joints as specified in ASTM D3139 or shall be compression type joints / mechanical joints as respectively specified in ASTM D3139 and AWWA C111. Provide each joint connection with an elastomeric gasket suitable for bell or coupling or push-on joints with which it is to be used.

3. Transition from PVC to ductile iron pipe shall occur a minimum of 5 feet from building.

D. All underground piping for fire mains shall be installed, clamped, anchored, flushed and hydrostatically pressure tested according to the requirements of the authorities and/or agencies having jurisdiction, and NFPA Pamphlets Nos. 13 and 24 and F. M. Handbook of Industrial Loss Prevention.

E. Anchor underground riser stub to nearest underground connection by means of rodding. Retaining glands with setscrews above grade are not allowed.

2.4 UNDERGROUND PIPE COATING:

A. All underground ferrous piping shall be covered with:

1. Either two coats of 10 Mill Scotch Wrap No. 51, or with;

2. "XTRU-COAT" prefabricated extruded cover with joints sealed with two coats of 10 Mill Scotch Wrap #51.

3. Or approved equal

2.5 THRUST BLOCKS

A. Provide thrust blocks at changes in pipe direction, changes in pipe sizes, dead-end stops and at valves.

B. Calculate area of undisturbed earth of thrust block based on actual soil conditions and water test pressure of 200 psi.

C. Concrete and reinforcing steel shall be as specified in Division 03 and 05. All concrete shall be Class A, unless specified otherwise.

D. Miscellaneous nuts and bolts shall be stainless steel.

2.6 RODS AND CLAMPS

A. Socket clamps shall be stainless steel; four bolt type, equipped with stainless steel socket clamp washers and nuts Grinnell Fig. 595 and 594, Elcen Fig. 37 and 37X, or equal.

B. Rods shall be stainless steel, 3/4" diameter.

2.7 SPRINKLER HEADS - GENERAL

A. Sprinkler heads shall be regular automatic closed-type heads of ordinary degree temperature rating except that sprinkler heads installed in the vicinity of heating equipment or in special occupancy areas shall be of the temperature rating as described in NFPA No. 13.

B. Provide quick response heads in all new light hazard occupancies. For existing sprinkler systems, response type to match existing type unless otherwise noted.

C. Provide corrosion-resistant sprinkler heads where they are exposed to weather, moisture or corrosive vapors.

D. The Contractor shall furnish spare heads. The heads shall be packed in a suitable container and shall be representative of, and in proportion to, the number of each type and temperature rating head installed. In addition to the spare heads, the contractor shall furnish not less than two special sprinkler head wrenches. Refer to NFPA 13 section; "Stock of Spare Heads".

E. Provide flexible connectors for heads located in suspended ceilings. Do not use oversized escutcheons.

2.8 SPRINKLER HEADS

A. Sprinkler heads installed shall be upright or pendent, as conditions require, and shall be of the following type and finish for the areas designated. Unless otherwise specified, sprinklers shall be small frame type, center bulb capsule for finished areas, fusible link for unfinished areas, and ½" orifice. Extended coverage heads not allowed in unfinished area.

Building Area	Sprinkler Head	Sprinkler Finish	Escutcheon Finish	Temp. Deg.
Unfinished, , Utility & Mechanical Rooms	Upright/Pendant	Brass	None	165°F
Electrical, Telephone & Switchgear Rooms	Upright	Brass	None	286° F
	Concealed Pendant	Brass	White Coverplate	165° F
Soffit	Flush Sidewall	White/Custom	White	165°F
Sidewall	Horizontal Sidewall	Brass	None	165°F
Balconies	Dry Sidewall	Brass	Chrome	155°F

B. Manufacturer: Tyco, Reliable or Viking.

2.9 VALVING

A. 2" or Smaller:

1. Control Valve: OS&Y rising stem type gate valve bronze body, bonnet and disc, copper alloy stem, threaded ends, 175 psig WOG min. Provide with tamper switch.

2. Check Valve: Swing check type with bronze body, cap and disc, threaded ends, 175 psig WOG min.

3. Drip Valve: 3/4", cast brass automatic ball drip type, threaded ends, 175 psig WOG min.

4. Testing Valve: 1-1/4", test and drain, sight glass, ½" test orifice, lever operated, 300 psig WOG. Drain to mop sink or drain riser.

5. Main Drain Valve: 2", angle gate valve, bronze body, copper alloy stem, threaded ends, 175 psig WOG. Drain to mop sink or drain riser.

B. 2-1/2" or Larger:

1. Control Valve: Grooved butterfly valve with tamper switch, ductile iron body, aluminum bronze disc, stainless steel stem and EPDM Liner, 200 psig WOG min, Victanlic 700.

2. Control Valve: OS&Y rising stem type gate valve, cast iron body and bonnet, bronze stem, seat and disc, flanged ends, 175 psig WOG min. Provide with tamper switch.

3. Check Valve: Swing check type with cast iron body, bolted cap and disc, flanged ends, 175 psig WOG min.

4. Manufacturer: Grinnell, Stockham, Milwaukee, Mueller, Kennedy, Elkart or AGF.

2.10 WET SPRINKLER ALARM CHECK VALVE

A. Contractor shall provide, where required, a completely engineered horizontal wet alarm check valve, retarding chamber, and trim assembly. Viking #F-1, Star or Reliable.

2.11 VALVE BOXES

A. Cast iron valve boxes for shutoff valves buried in ground shall be complete with bellbottoms, extension piece, top and cover. Boxes shall be suitable for the types of valves with which they are used. All valve boxes shall have a concrete collar flush with grade.

B. Lids shall have the applicable letters embossed upon the top surface. Tagging shall match existing lids.

C. Manufacturer: Tyler, ITT Grinnell, or equal.

2.12 TEST AND SYSTEM DRAIN

A. Combination system drain and visible orifice insert/sight glass for testing system alarm; with screwed or grooved inlet and outlet connections, Malleable iron hand wheel, EPDM valve seats, maximum working pressure 300 psi, 1/2" orifice insert, Bronze housing ,UL listed and FM Approved. Victaulic TestMaster II style 720, or approved equal.

B. Water pressure gauge, range 0-300, in 5 psig increments, brass case - 3-1/2" diameter, 1/4" NPT male pipe connection, UL listed. Locate pressure gage on riser per code. Star Sprinkler, Ashcroft or approved equal.

C. Pressure gauge test valve, brass 1/4" screwed ends, 300 psig WOG. United or approved equal.

D. All relief, main, auxiliary and equipment drains shall be routed separately to floor drain or air gap fitting (by plumbing).

2.13 TAMPER SWITCHES

A. Switch shall be mounted so as not to interfere with normal operation of the valve and be adjusted to operate when handle of valve has traveled more than one-fifth the distance of its normal operating position. Electrical Contractor shall provide conduit from switch to fire alarm panel.

B. Housing shall be of aluminum, acid-treated, primed and finished in baked red enamel. Removal of housing shall cause switch to operate. Inside shall be single pole, double throw micro switch with connection for electrical conduit.

C. Install on all control valves.

D. Manufacturer: Potter-Electric, Notifier, Ellenco, or Simplex.

2.14 EXTERIOR ALARM

A. Electric bell, 10" diameter, U.L. listed, weather-proof back box housing, 120 VAC, 99 dB at 10 FT; Potter model PBA12010 or equal.

B. Electric Horn: Potter-Electric, Ellenco, Notifier, or Simplex weatherproof, 120 VAC.

2.15 DRY-PIPE VALVE SYSTEM

A. Contractor shall provide where indicated on drawings a completely engineered dry-pipe valve assembly in accordance with NFPA Pamphlet No. 13.

B. Space shall be provided for all valving required. Dry-pipe alarm valve(s) shall be of the differential type with all accessories including, but not limited to, the following:

1. Alarm Valve, Trim, Pressure Switch with auxiliary contacts for fire alarm connection, Water gong, Air maintenance device, listed air compressor unit designed to fill system in a minimum of thirty minutes, Dry type valves supplying more than 300 sprinkler heads shall be provided with quick opening device (accelerator).

C. Manufacturer: Viking #E, Star or Reliable.

2.16 FIRE DEPARTMENT CONNECTIONS

A. Flush wall mounted unit or freestanding unit with individual clapper valves, plugs and chains, locations as indicated on drawings. Escutcheon plate to be lettered as follows; “AUTO SPRINKLER”, “DRY STANDPIPE” or “AUTO SPRINKLER AND STANDPIPE”. Unit shall be polished chrome or brass finish, mounted 36" above finished grade. Number of inlets required shall be in accordance with regulations of the Fire Marshal or local fire department.

2.17 POST INDICATOR VALVE

A. Indicator post valve and indicator post. Clow # 2925 or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. This system to be installed by an experienced firm regularly engaged in the installation of automatic sprinkler system as specified by the requirements of the Specifications.

3.2 PERFORMANCE OF WORK

A. Examine areas and conditions under which materials are to be installed. Layout the system to suit the different types of construction and equipment as indicated on the drawings and in accordance with NFPA Pamphlet No. 13, 14, 20 and 24.

B. Work to start immediately after authorization has been given to proceed so that the overall progress of the construction is not delayed.

C. Coordinate with other trades as necessary to properly interface components of the sprinkler system.

D. Follow manufacturer's directions and recommendations in all cases.

E. The omission from the drawings or Specifications of any details of construction, installation, materials, or essential specialties shall not relieve the Contractor from furnishing the same in place for a complete system.

3.3 TEMPORARY FIRE PROTECTION

A. Provide all temporary valving, piping, Siamese connections and other components as directed by the fire agency office during all phases of construction.

3.4 INSTALLATION - GENERAL

A. Fire protection system shall be installed in accordance with the approved Drawings. The finished ceiling is not to be erected until all fire protection piping has been installed, tested, and inspected. Sprinkler heads located in the electrical equipment, elevator, or similar rooms shall be furnished with deflectors to prevent water spray on equipment.

B. Before connection to the overhead piping, all underground piping shall be flushed with water flowing at velocity and quantity required by the installation standards specified above in this Section of the Specifications.

C. The arrangement of all pipes shall conform to all architectural requirements and field conditions, shall be as straight and direct as possible, forming right angles or parallel lines with building walls and other pipes, and shall be neatly spaced. Offsets will be permitted only where required to permit the pipes to follow the walls. Standard fittings shall be used for offsets. All risers shall be erected plumb and true, shall be parallel with the walls and other pipes, and shall be neatly spaced. All work shall be coordinated with HVAC, Plumbing, Electrical and Structural work in order to avoid interference and unnecessary cutting of floors or walls. All underground or concealed work shall be inspected before the construction is closed up.

D. All sprinkler heads to be installed in ceilings throughout the scope of work building as listed in Part 2 sections. All areas without ceilings shall have rough brass upright or pendent heads as shown on drawings.

E. Sprinkler heads in all finished areas are to be installed on a true axis line in both directions, with maximum deviation from the axis line of 1/2 inch plus or minus and shall be plus or minus 1" within center of tile. At the completion of the installation, if any heads are found to exceed the above-mentioned tolerance, they shall be removed and reinstalled.

F. No pipes or other apparatus shall be installed so as to interfere in any way with full swing of doors.

G. The arrangement, positions, and connections of pipes, drains, valves, etc., shall be as required by NFPA Pamphlet #13 for all areas to be sprinklered. At all low points provide drains and provide drains or capped tees fittings at isolated low points in the piping system. However, the right is reserved by the Owner's Representative to change the location of any item to accommodate conditions, which may arise during progress of the work, without additional compensation for such changes provided that no additional heads are required prior to the installation of the work.

H. Where required, piping shall be installed concealed in building construction, or though steel beams, to obtain adequate head room.

I. All pipe throughout the job shall be reamed smooth before being installed. Pipe shall not be split, bent, flattened, or otherwise injured either before or during installation.

J. Provide protective pans under pipes passing over high voltage electrical bus duct or switchgear equipment. The pan shall be constructed of 12 gauge black iron with a 6 inch lip, the corners being welded to make the pans watertight. Each pan shall be given three coats of Rust-Oleum paint and shall be supported by pipe hangers. The pan shall drain clear of the bus duct or switchgear.

K. All pipe interiors shall be thoroughly cleaned of foreign matter before installation, and shall be kept clean during installation by plugging or other approved means. Piping shall be covered with visqueen during storage. Piping that shows signs of rusting will be removed from job site and replaced.

L. Field Connections: Any modifications to system required by field conditions, physical equipment changes or compliance with code regulations shall be made promptly without cost to Owner.

M. Interference: No piping or sprinkler devices shall interfere with the operations of any door, window, or mechanical and/or electrical systems. No part of this system shall visibly installed in the physical parameter of any window. Sprinkler mains and branch piping shall not interfere with existing or future ceiling, light fixtures and HVAC diffusers.

N. Threaded Pipe: Threads shall be clean cut, standard and tapered. Threads shall be made up using flaked graphite and lubricating oil, piping compound or Teflon tape applied to the male threads only.

O. Grooved Pipe: Installation shall be as prescribed in the Victaulic Piping Manual only. Holes in the piping are to be made in the fabrication shop, not at the job site. Contractor shall provide at the project site a sample of each type of coupling (threaded, standard grooved coupling and mechanical type), showing complete assembly with pipe connections. Couplings will not be installed until samples are approved by the Owner's Representative. Owner's Representative approval does not eliminate the Contractor's final approval by the fire agency's office.

P. Keep all pipe and other openings closed to prevent entry of foreign matter. Cover all equipment and apparatus to protect against dirt, water, chemical or mechanical damage, before and during construction period. Restore to original condition all apparatus and equipment damaged prior to final acceptance, including restoration of damaged shop coats of paint.

Q. Location of sprinkler piping is critical.

1. Where ceiling space is at a minimum under beams location of ductwork takes precedence, coordinate accordingly.

2. Include in base bid, multiple coordination meetings, as required with Owner's Representative for coordination of sprinkler pipe routing, at no additional cost to the Owner.

3. Coordinate beam and shear wall penetrations with Structural Engineer. Obtain written approval for all beam penetrations from Structural Engineer.

R. Elevator Pits: For hydraulic elevators provide sprinkler heads in elevator pits per elevator code. Provide control valve with tamper switch to each pit area. Coordinate with Division 26 Fire Alarm System.

S. Tracer wire shall be wrapped and taped to non-metallic underground piping at maximum 20 foot intervals.

3.5 EXCAVATION AND BACKFILL

A. Trench and excavation work shall be done in a neat workmanlike manner, of the depth required by the authorities and/or agencies having jurisdiction. Pipe crown shall not be less than 30 inches below the finished ground surface. After the pipe has been properly tested and inspected, trench shall be backfilled with sand, or an approved sandy material, to a depth of 6 inches above the pipe. Backfill material shall be consolidated by tamping or by saturating with water and vibrating. Subsequent backfill shall consist of the original excavated material, free of organic matter, placed in 6 inch layers and compacted layer by layer by means of power driven vibrators.

B. Replace to original condition all turf, plants, concrete, asphalt, or other improvements disturbed by trenching. In graded, unpaved areas, backfill trenches with crown 8 inches above the surrounding surface.

3.6 SLEEVES AND FLASHINGS

A. Wherever pipes are exposed and pass through walls, floors, partitions or ceilings, they shall be fitted with chromium plated steel escutcheons held in place with setscrews. Care shall be taken to protect the escutcheons during the course of construction.

B. Penetrations through fire rated walls and floors shall be sealed with listed mastic of similar fire rating.

3.7 HANGERS, INSERTS, SUPPORTS, AND SWAY BRACING

A. Hangers and supports shall be installed per NFPA #13 sections on Hangers and Protection of Piping Against Damage Where Subject to Earthquake. Provide restraint from movement at end sprinkler on branch line per NFPA 13.

B. Bending of threaded hanger rod is not allowed. All powder driven anchor pins in concrete are not allowed.

3.8 SAFETY TESTING & VERIFICATION

A. Flush, test, and inspect sprinkler piping systems according to NFPA 13 Chapter "System Acceptance."

B. Provide NFPA 13 Contractor's Material & Test Certificate Form 85A for above ground piping and Form 85B for underground piping.

C. Provide manpower to test the function and performance of all Life Safety System components and devices per floor and per zone basis in accordance with the local requirements.

3.9 IDENTIFICATION

A. In addition to the requirements of Section 210500, provide pipe markers every 20 feet, once in every room, and at each building level traversed, minimum. Provide hydraulic design data nameplates on the riser of each sprinkler system in accordance with NFPA 13

B. Equipment such as valves, drains, etc., shall be provided with signs that identify type of equipment and service. The tag shall be securely fastened to the handle or spindle of the valve by a brass chain. Furnish four schedules of valves so tagged. There shall also be furnished four diagrammatic charts showing schematically the complete sprinkler system with major control valves and numbers thereof. One set of Schedules and charts shall be mounted in glazed frames located where directed.

3.10 AS-BUILT RECORD DRAWINGS AND CERTIFICATION

A. As-built Record Drawings are to be kept up-to-date and the Master Copy kept at the job site. Prior to final acceptance of work being approved, these drawings are to be turned over to the Owner's Representative for approval.

B. Written certification from the insuring agents, and authorities having jurisdiction that the tests were satisfactory.

C. After installation is complete and tests satisfactorily approved, deliver test certificates and approval by the local Fire Authorities and the FMA to the architect. Final acceptance of sprinkler/standpipe system by Owner's Representative shall be contingent upon receipt of certificate and approval from authorities having jurisdiction and for the delivery of final As-Built Drawings.

END OF SECTION

BASIC MATERIALS AND METHODS - PLUMBING

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 01 - General Requirements, and shall include all Plumbing Sections specified herein.

1.2 SCOPE OF THIS SECTION

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Compliance with all codes and standards applicable to this jurisdiction.
2. Shop Drawings for Equipment
3. Coordination Documents
4. Record Drawings
5. Start-up Service and Building Commissioning
6. Instruction, Maintenance, and O & M Manuals
7. Work associated with Delivery, Storage, and Handling of products
8. Work associated with provision of Temporary Facilities
9. Preparation of Posted Operating Instructions
10. Meeting Project Safety and Indemnity requirements
11. Proper Cleaning and Closing
12. Supplying proper Warranty information
13. Supply specified Guarantee documentation
14. Design and provision of Supports and Anchors
15. Design and provision of Seismic Restraints and Vibration Isolation
16. Pipe Portals
17. Equipment Rails
18. Access Panels and Doors
19. Identification Markers

20. Coordination of Electrical requirements for equipment provided

1.3 DESCRIPTION OF WORK

A. The Contract Documents, including Specifications and Construction Drawings, are intended to provide all material and labor to install complete plumbing systems for the building and shall interface with all existing building systems affected by new construction.

B. The Contractor shall refer to the plumbing, architectural interior details, floor plans, elevations, and the structural and other Contract Drawings and she shall coordinate her work with that of the other trades to avoid interference. The plans are diagrammatic and show generally the locations of the fixtures, equipment, and pipe lines and are not to be scaled; all dimensions and existing conditions shall be checked at the building.

C. The Contractor shall comply with the project closeout requirements as detailed in General Requirements of Division 01.

1.4 DESCRIPTION OF BID DOCUMENTS

A. Specifications:

1. Specifications, in general, describe quality and character of materials and equipment.

2. Specifications are of simplified form and include incomplete sentences.

B. Drawings:

1. Drawings in general are diagrammatic and indicate sizes, locations, connections to equipment and methods of installation.

2. Before proceeding with work check and verify all dimensions.

3. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.

4. Make adjustments that may be necessary or requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.

5. If any part of Specifications or Drawings appears unclear or contradictory, apply to Architect or Engineer for his interpretation and decision as early as possible, including during bidding period.

1.5 DEFINITIONS

A. "Above Grade": Not buried in the ground and not embedded in concrete slab on ground.

B. "Actuating" or "Control" Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

C. "Below Grade": Buried in the ground or embedded in concrete slab on ground.

D. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

E. "Connect": Complete hook-up of item with required service.

F. "Exposed": Not installed underground or "concealed."

G. "Furnish": To supply equipment and products as specified.

H. "Indicated," "Shown" or " "Noted": As indicated, shown or noted on Drawings or Specifications.

I. "Install": To erect, mount and connect complete with related accessories.

J. “Lead Free”: Materials containing not more than 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent when used with respect to the wetted surfaces of pipes and pipe fittings, plumbing fittings, and fixtures, providing a specified definition and formula for determining “weighted average”.

K. "Motor Controllers": Manual or magnetic starters (with or without switches), individual push buttons or hand-off-automatic (HOA) switches controlling the operation of motors.

L. "Piping": Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

M. "Provide": To supply, install and connect as specified for a complete, safe and operationally ready system.

N. "Reviewed," "Satisfactory" or "Directed": As reviewed, satisfactory, or directed by or to Architect/Engineer/Owner.

O. "Rough-In": Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

P. "Shall": An exhortation or command to complete the specified task.

Q. "Similar" or "Equal": Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

R. "Supply": To purchase, procure, acquire and deliver complete with related accessories.

S. “Typical” or “Typ”: Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

T. "Will": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall."

U. "Wiring": Raceway, fittings, wire, boxes and related items.

V. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

1.6 RELATED WORK SPECIFIED ELSEWHERE

A. All Division 22 Plumbing sections included herein.

B. Division 02: Existing Conditions

1. Coordination of excavation of trenches and the installation of piping on site.

C. Division 03: Concrete.

1. All concrete work for Plumbing Division shall be included in Division 22 under the appropriate Sections and shall include:

a. Concrete curbs and housekeeping pads for the mechanical equipment.

b. Thrust blocks, pads, and boxes for mechanical equipment.

c. Coordination of floor drain and floor sink installations in sloped floors.

D. Division 05

E. Division 07: Thermal and Moisture Protection.

1. Flashing and sheet metal

2. Sealants and caulking

3. Firestopping

F. Division 09: Finishes:

1. Division 22 installers shall perform all painting, except where specifically stated otherwise in Division 09.

2. Painting of all exposed steel, piping, insulation, equipment, and materials.

G. Division 26: Electrical is related to work of:

1. Power connections to all plumbing equipment

2. Life safety provisions

1.7 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or

drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Perform all tests required by governing authorities and required under all Division 22 Sections. Provide written reports on all tests.

C. Electrical devices and wiring shall conform to the latest standards of NEC; all devices shall be UL listed and labeled.

D. All plumbing work shall comply with the Americans with Disabilities Act (ADA).

E. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

F. Provide in accordance with rules and regulations of the following:

a. Building Codes enforced by the Authority Having Jurisdiction in Oregon:

b. 2014 Oregon Structural Specialty Code (OSSC) based on 2012 International Building Code (IBC)

c. 2014 Oregon Energy Efficiency Code (OEESC) based on the 2009 International Energy Conservation Code (IECC)

d. 2014 Oregon Mechanical Specialty Code (OMSC) based on 2012 International Mechanical Code (IMC) and 2012 International Fuel Gas Code (IFGC) with State Amendments

e. 2014 Oregon Plumbing Code (OPC) based on 2009 Uniform Plumbing Code (UPC) with State Amendments

f. 2014 Oregon Fire Code (Based on the 2012 International Fire Code)

g. 2014 Oregon Electric Specialty Code (Based on the 2014 National Electric Code (NEC) with State Amendments

h. State Amendment

2. Local, city, county and state codes and ordinances

3. Local Bureau of Buildings

4. Local Health Department

5. Local and State Fire Prevention Districts

6. State Administrative Codes

7. University of Oregon Construction Standards-Latest Edition.

G. Provide in accordance with appropriate referenced standards of the following:

1. NFPA - National Fire Protection Association
2. CSA - Canadian Standards Association
3. ANSI - American National Standards Institute
4. ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers
5. ASME - American Society of Mechanical Engineers
6. ASTM - American Society for Testing Materials
7. AWS - American Welding Society
8. AWWA - American Water Works Association
9. FM - Factory Mutual
10. MSS - Manufacturer's Standardization Society
11. NEMA - National Electrical Manufacturer's Association
12. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
13. UL - Underwriter's Laboratories
14. ADA - Americans with Disabilities Act
15. ETL - Electrical Testing Laboratories
16. ASSE - American Society of Sanitary Engineers
17. PDI - Plumbing and Drainage Institute
18. IAPMO - International Association of Plumbing and Mechanical Officials
19. CISPI - Cast Iron Soil Pipe Institute

1.8 QUALITY ASSURANCE

A. Manufacturer's Nameplates: Nameplates on manufactured items shall be aluminum or Type 304 stainless steel sheet, not less than 20 USG (0.0375”), riveted or bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of equipment data.

B. Current Models. All work shall be as follows:

1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.

2. Replacement parts shall be readily available and stocked in the USA.

C. Experience: Unless more stringent requirements are specified in other sections of Division 22, manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than one year prior to the date of bidding for this project.

1.9 GENERAL REQUIREMENTS

A. Examine all existing conditions at building site.

B. Review contract documents and technical specifications for extent of new work to be provided.

C. Provide and pay for all permits, licenses, fees and inspections.

D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for mechanical access.

E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to Equipment Specifications in Divisions 02 through 48 for rough-in requirements.

F. Coordinate mechanical equipment and materials installation with other building components.

G. Verify all dimensions by field measurements.

H. Arrange for chases, slots, and openings in other building components to allow for plumbing installations.

I. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

J. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

K. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Contractor to provide for all cutting and patching required for installation of his work unless otherwise noted.

L. Where mounting heights are not detailed or dimensioned, install plumbing services and overhead equipment to provide the maximum headroom possible.

M. Install plumbing equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations.

N. Coordinate the installation of plumbing materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, sprinkler piping and heads, and other installations.

O. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

P. All materials (such as insulation, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

Q. Coordinate installation of floor drains and floor sinks with work of other trades, such that finished floor slopes to drains and floor sinks are flush with surrounding floor.

R. Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this Division. Any such products installed as part of the work of the Division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor.

S. Pipes, pipe fittings, plumbing fittings and fixtures that come into contact with the wetted surface of a public water system or any plumbing in a facility providing water for human consumption shall be “Lead Free”.

1.10 MINOR DEVIATIONS

A. The Drawings are diagrammatic and show the general arrangements of all plumbing work and requirements to be performed. It is not intended to show or indicate all offsets, fittings, and accessories which will be required as a part of the work of this Section.

B. The Contractor shall review the structural and architectural conditions affecting his work. It is the specific intention of this section that the contractor's scope of work shall include

1. Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications

2. Minor deviations from the plumbing plans required by architectural and structural coordination.

C. The Contractor shall study the operational requirements of each system, and shall arrange his work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the proper and efficient installation of all systems from the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the "Electrical Work." Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labor and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

D. Minor deviations in order to avoid conflict shall be permitted where the design intent is not altered.

E. Advise the Architect, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Architect of conflict.

1.11 PRODUCT SUBSTITUTIONS

A. The Contractor shall certify the following items are correct when using substituted products other than those scheduled or shown on the drawings as a basis of design:

1. The proposed substitution does not affect dimensions shown on drawings.

2. The Contractor shall pay for changes to building design, including engineering design, detailing, structural supports, and construction costs caused by proposed substitution.

3. The proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.

4. Maintenance and service parts available locally are readily obtainable for the proposed substitute.

B. The Contractor further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item.

C. The Contractor agrees that the terms and conditions for the substituted product that are found in the contract documents apply to this proposed substitution.

1.12 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with Division 01 requirements.

B. After approval of preliminary list of materials, the Contractor shall submit Shop Drawings and manufacturer's Certified Drawings to the Architect for approval.

C. The Contractor shall submit approved Shop Drawings and manufacturer's equipment cuts, of all equipment requiring connection by Division 26, to the Electrical Contractor for final coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate with Division 26.

D. Submittals and Shop Drawings shall be submitted as a complete package bound in a 3-ring binder with tabs for each specification section. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Submit six (6) typed copies of submittals. Refer to Division 01 for additional requirements.

1.13 UNIT PRICING SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with Division 01 requirements.

B. Preliminary List of Materials and Unit Price Items: Within thirty (30) days after awarding of the Contract, submit to architect for preliminary approval a complete list of manufacturer's names and model numbers of proposed materials and equipment. Also include proposed list of unit price items for review.

1. Indicate substituted items.

2. Identify test and balancing agency.

3. Identify independent testing laboratory for water analysis.

C. The Contractor shall submit with preliminary list of materials a unit price list for each item furnished on this project. Included with price shall be labor cost index.

D. Submittals and Shop Drawings shall be submitted as a complete package bound in a 3-ring binder with tabs for each specification section. Submit six (6) typed copies of submittals. Refer to Division 01 for additional requirements.

1.14 COORDINATION DOCUMENTS

A. The Contractors shall prepare coordinated Shop Drawings to coordinate the installation and location of all equipment, piping and all system appurtenances with other trades. The Drawings shall include all equipment rooms and floor plans. The Drawings shall be Overlay Drawings showing each discipline on a single sheet. The Drawings shall be keyed to the structural column identification system, and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Architect and the structural requirements, and all other trades (including HVAC, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide reasonable maintenance access requirements. When conflicts are identified, modify system layout as necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor, Architect, and Owner. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

B. The Drawings shall be prepared as follows:

1. The Sheet Metal (Mechanical) Contractor shall prepare Drawings to an accurate scale of 1/4" = 1'-0" or larger, on reproducible media sheets (vellum) or AutoCAD disks. Obtain

reproducibles or AutoCAD files of the HVAC design from the Architect, or Engineer, at cost plus. Drawings are to be same size as Contract Drawings and shall indicate location, size and elevation above finished floor, of all HVAC equipment, ductwork, and piping. Plans shall also indicate proposed ceiling grid and lighting layout, as shown on electrical plans and reflected ceiling plans.

2. The Plumbing Contractor shall obtain reproducible plans or AutoCAD disks from the Mechanical Contractor, and indicate all plumbing lines including fittings, hangers, access panels, valves, and bottom of pipe elevations above finished floor.

3. The Fire Protection Contractor shall obtain reproducible plans or AutoCAD disks with the detailed mechanical and plumbing work shown. The Sprinkler Contractor shall indicate location of all sprinkler heads and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.

4. Plans are to incorporate all addenda items and change orders.

5. Distribute plans to all trades and provide additional coordination as needed.

C. Advise the Architect in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Architect of conflict.

D. Provide means of access to all valves, controllers, operable devices, and other apparatus that may require adjustment or servicing.

E. Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Architect of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

F. Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

G. Provide copy of Record Drawings to Testing and Balancing Contractor for their use when doing their work.

1.15 RECORD DRAWINGS

A. Before commencing installation, obtain an extra set of prints from Architect, marked "Record." Keep this set of Drawings at the job site at all times, and use it for no other purpose but to mark on it all the changes and revisions to the Contract Drawings resulting from coordination with other trades. At the completion of the project:

1. Edit project electronic image files, such as AutoCAD/Revit, to incorporate all site markups, changes, and revisions to the Contract Drawings. Submit plots of Record Drawings and six copies CD Roms labeled with all record electronic image drawing files.

B. Provide copy of Record Drawings to Testing and Balancing Contractor for use when doing his work.

C. Mark Drawings to indicate revisions to piping size and location, both exterior and interior; including locations of control devices, valves, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e. – valves, traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

D. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

E. Refer also to Special Conditions in Division 01 for full scope of requirements.

1.16 START-UP SERVICE AND BUILDING COMMISSIONING

A. Prior to start-up, be assured that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

B. Provide services of factory-trained technicians for start-up of temperature controls, boilers, pumps, and other major pieces of equipment. Certify in writing compliance with this Paragraph, stating names of personnel involved and the date work was performed.

C. Refer to other Division 22 Sections for additional requirements.

1.17 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. O&M Manuals: Upon completion of the work, the Contractor shall submit to the Architect complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section, bound in a durable binder. Refer to Division 01.

B. The Contractor shall be responsible for proper instruction of Owner's personnel for operation and maintenance of equipment, and apparatus installed as specified in Division 22 to be no less than 2 hours for each piece of equipment.

1.18 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping shall be stored in bundles covered with visqueen. Piping showing signs of rust shall be removed from site and replaced.

C. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for

the smooth and efficient flow of installations.

1.19 TEMPORARY FACILITIES

A. Refer to Division 01 for the requirements of temporary water and sewer for construction and safety. Provide temporary water, and sewer, etc. services as necessary during the construction period and as required to maintain operation of existing systems.

1.20 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.21 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal hours of work.

B. No act, service, Drawing, review, or Construction Review by the Owner, Architect, the Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify and defend the Owner, the Architect, the Engineers and their consultants, and each of their officers, employees and agents from any and all liability claim, losses or damage arising, or alleged to arise from bodily injury, sickness, or death of a person or persons, and for all damages arising out of injury to or destruction of property arising directly or indirectly out of, or in connection with, the performance of the work under the Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the Construction Contract Documents; but not including the sole negligence of the Owner, the Architect, the Engineers, and their consultants or their officers, employees and agents.

1.22 CLEANING AND CLOSING

A. All work shall be inspected, tested, and approved before being concealed or placed in operation.

B. Upon completion of the work, all equipment installed as specified in this section, and all areas where work was performed, shall be cleaned to provide operating conditions satisfactory to the Architect.

1.23 WARRANTIES

A. All equipment shall be provided with a minimum one-year warranty to include parts and labor. Refer to individual Equipment Specifications for extended or longer-term warranty requirements.

B. Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

C. Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period.

1.24 GUARANTEE

A. The Contractor shall guarantee and service all workmanship and materials to be as represented by him and shall repair or replace, at no additional cost to the Owner, any part thereof which may become defective within the period of one (1) year after the Date of Final Acceptance, ordinary wear and tear excepted.

B. Contractor shall be responsible for and pay for any damages caused by or resulting from defects in his work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

B. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be considered to be subsequent to all manufacturers’ names used herein, unless specifically noted that substitutes are not allowed.

2.2 SUPPORTS AND ANCHORS

A. General: Comply with applicable codes pertaining to product materials and installation of supports and anchors, including, but not limited to, the following:

1. UL: Provide products which are UL listed.

2. FM: Provide products which are FM approved.

3. ASCE 7-05: “American Society of Civil Engineers.”

4. 2009 International Building Code (IBC)

5. MSS Standard Compliance: Manufacturer's Standardization Society (MSS).

6. SMACNA: "Seismic Restraint Manual: Guidelines for Mechanical Systems."

7. NFPA: Pamphlet number 13 and 14 for fire protection systems.

8. Provide copper plated or plastic coated supports and attachment for copper piping systems. Field applied coatings or tape is unacceptable.

9. Manufacturer: B-Line, Anvil International, Michigan, Tolco, Kin-Line, Simpson, or Superstrut.

B. Horizontal Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated hangers and supports of one of the following MSS types listed.

1. Adjustable Steel Clevis Hangers: MSS Type 1.

2. Adjustable Steel Swivel Band Hangers: MSS Type 10.

3. U-Bolts: MSS Type 24.

4. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:

a. Plate: Unguided type.

b. Plate: Guided type.

c. Plate: Hold-down clamp type.

5. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast iron floor flange.

6. Pipe Saddle Supports with U-Bolt: MSS Type 37, including steel pipe base support and cast iron floor flange.

7. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast iron floor flange.

8. Single Pipe Roller with Malleable Sockets: MSS Type 41.

9. Adjustable Roller Hangers: MSS Type 43.

10. Pipe Roll Stands: MSS Type 44.

11. Pipe Guides: Provide factory-fabricated guides of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

C. Horizontal Cushioned Pipe Clamp: Where pipe hangers are called out to absorb vibration or shock install a piping clamp with thermoplastic elastomer insert. Cush-A-Clamp or equal.

D. Vertical Piping Clamps: Provide factory-fabricated two-bolt vertical piping riser clamps, MSS Type 8.

E. Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of one of the following MSS types listed.

1. Steel Turnbuckles: MSS Type 13.

2. Steel Clevises: MSS Type 14.

3. Swivel Turnbuckles: MSS Type 15.

4. Malleable Iron Eye Sockets: MSS Type 16.

5. Steel Weldless Eye Nuts: MSS Type 17.

F. Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments of one of the following types listed.

1. Concrete Inserts: MSS Type 18 or Blue Banger Hanger by Simpson

2. Steel Brackets: One of the following for indicated loading:

a. Light Duty: MSS Type 31.

b. Medium Duty: MSS Type 32.

c. Heavy Duty: MSS Type 33.

3. Horizontal Travelers: MSS Type 58.

4. Internally Threaded Expansion Shell Anchors: By Simpson or approved equal.

5. Concrete Screw Anchors: Titen HD by Simpson or approved equal.

6. Anchor Bolts: Heavy duty, drilled-in concrete expansion wedge anchor bolts, Hilti or Red Head.

G. Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

1. Pipe Covering Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

2. Insulation Protection Shields: MSS Type 40, 18" minimum, or of the length recommended by manufacturer to prevent crushing of insulation. High-density insulation insert lengths shall match or exceed shield length.

3. Thermal Hanger Shields: Constructed of 360° insert of waterproofed calcium silicate (60 psi flexural strength minimum) encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation. Shield length shall match or exceed length of calcium silicate insert. Alternately Polyisocyanurate Urethane with a minimum flexural strength of 60psi, fully encased in 360 PVC (1.524 mm thick) SNAPPITZ. Provide assembly of same thickness as adjoining insulation.

4. Thermal Hanger Couplings: Constructed of high strength plastic coupling to retain tubing and join insulation at clevis hangers and strut-mounted clamps. Klo-Shure Insulation Coupling or equal.

H. Miscellaneous Materials:

1. Metal Framing: Provide products complying with NEMA STD ML1.

2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A36.

3. Cement Grout: Portland Cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand by volume, with minimum amount of water required for placement and hydration.

4. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required. Weld steel in accordance with AWS standards.

5. Pipe Brackets: "HoldRite" copper plated brackets. Insulate brackets attached to metal studs with felt.

2.3 SEISMIC RESTRAINT/VIBRATION ISOLATION REQUIREMENTS

A. Equipment, piping, and all system appurtenances (including weight of normal operating contents) shall be adequately restrained to resist seismic forces. Restraint devices shall be designed and selected to meet seismic requirements as defined in Chapter 16 of the latest edition of the Building Code with State Amendments, and applicable local codes in accordance with Seismic Zone D, and the applicable Importance Factors and Soil Factors.

B. All anchorages and/or seismic restraints shall be designed by a registered professional Civil or Structural Engineer licensed in the state of the project. Design shall include:

1. Number, size and location of anchors for floor or roof-mounted equipment. For curb mounted equipment, provide design of attachment of both the unit to the curb and the curb to the structure.

2. Number, size and location of vibration isolators, seismic restraint devices and their anchorage for vibration-isolated and suspended equipment.

3. Number, size and location of braces and anchors for suspended piping and ductwork on shop drawings.

   a. The contractor must select a single seismic restraint system pre-designed to meet the requirements of the current version of the Building Code with State Amendments.

   b. Installations not addressed by the selected system must be designed, detailed and submitted along with the shop drawings.

   c. Maximum seismic loads shall be indicated on drawings at each brace location.

   d. Drawings shall bear the stamp and signature of the registered professional engineer licensed in the state of the project who designed the layout of the braces.

4. Manufacturers: Mason, M.W. Sausse, Kinetics or approved equal.

C. Rigidly Mounted Equipment: Floor mounted equipment weighing over 400 lbs. and suspended equipment and vessels of any weight shall be protected by properly sized anchor bolts or hanger rods and bracing and, if required, by additional seismic restraints as described above for isolated equipment.

D. All non-isolated piping and ductwork shall be protected in accordance with the SMACNA Guidelines. At the Contractor's option, for ease of installation, cable restraint system may be used. Installations not addressed in the SMACNA Guidelines shall be designed by a registered professional engineer who designed the seismic bracing for the suspended piping and ductwork.

E. Plumbing equipment and piping shall be vibration isolated in accordance with Section 220548 – Vibration Isolation of Plumbing Systems."

F. Submittals:

1. Confirmation of responsible design party (Shop Drawings received without this information will be rejected without review. Architect will be informed of potential delay of project.)

   a. The seismic manufacturer's representative or engineer responsible for preparing the specified seismic submittal package shall send the following documentation of qualification:

      1) The name and professional engineer's license number of the structural engineer who will be responsible for preparing, designing, and stamping the seismic shop drawing information.

2. Shop Drawings submittal

   a. Stamped seismic restraint calculations.

   b. The type, size and deflection of each isolator proposed.

c. Details for all the isolators with snubbers proposed and seismic bracing.

d. Details for steel frames to be used in conjunction with the isolation and seismic restraint of the items.

e. Clearly outlined procedures for installing and adjusting the isolators, seismic restraints and snubbers.

2.4 PIPE PORTALS

A. Where pipe portals are not provided by other sections of Specification, provide prefabricated insulated pipe portals as required for piping penetrating through the roof where shown on plans. Field built pipe portals are acceptable alternatives - provide detail of construction for review.

B. Standard pipe portals, unless otherwise noted, shall be constructed as follows:

1. Curb shall be constructed of heavy gauge galvanized steel with continuous welds on shell seams.

2. Insulation to be 1-½” thick, 3 lb density rigid fiberglass.

3. Curb to have a raised 3” (minimum), 45° cant.

4. Curb to have 1-1/2" x 1-1/2" wood nailer (minimum).

5. Curb height to be 8” (minimum) above roof deck.

6. Cant shall be raised to match roof insulation thickness.

7. Cover or flashing to be constructed of galvanized steel or other suitable material to provide sturdy weather tight closure. Provide collars and rubber nipples with draw bands of sizes required by piping. Size curb, cover and nipples per manufacturer's recommendations.

8. Manufacturer: Roof Products Systems or Pate.

2.5 EQUIPMENT/PIPING RAILS

A. Where equipment/pipe rails are not provided by other sections of Specification, provide prefabricated reinforced equipment rails as required for support of equipment and piping. Field built curbs are acceptable alternatives - provide detail of construction for review.

B. Standard equipment rail, unless otherwise noted, shall be constructed as follows:

1. Construct of heavy gauge galvanized steel with continuous welds on shell seams.

2. Provide internal reinforcing supports welded as required to meet application requirements.

3. Equipment rails to have raised 3” (minimum), 45° cant.

4. Equipment rails to have 1 1/2" x 1 1/2" wood nailer (minimum) and counterflashing.

5. Equipment rail height to be 6” (minimum) above roof deck.

6. Cant shall be raised to match roof insulation thickness.

C. Equipment rails to be constructed to meet equipment size and weight requirements. Provide tapered rails to match roof pitch where required.

D. Manufacturer: Pate, Vent Products, Thy Curb or Roof Products Systems.

2.6 ACCESS PANELS AND ACCESS DOORS

A. Provide all access doors and panels to serve equipment under this work, including those which must be installed, in finished architectural surfaces. Frame of 16-gauge steel, door of 20 gauge steel. 1” flange width, continuous piano hinge, key operated, prime coated. Refer to Architectural Specifications for the required product Specification for each surface. Contractor is to submit schedule of access panels for approval. Exact size, number and location of access panels is not shown on Plans. Access doors shall be of a size to permit removal of equipment for servicing. Access door shall have same rating as the wall or ceiling in which it is mounted. Provide access panel for each trap primer or concealed valve. Use no panel smaller than 12” x 12” for simple manual access, or smaller than 24" x 24" where personnel must pass through. Provide cylinder lock for access door serving mixing or critical valves in public areas.

B. Included under this work is the responsibility for verifying the exact location and type of each access panel or door required to serve equipment under this work and in the proper sequence to keep in tune with construction and with prior approval of the Architect. Access doors in fire rated partitions and ceilings shall carry all label ratings as required to maintain the rating of the rated assembly.

C. Acceptable Manufacturers: Milcor, Karp, Nystrom, or Elmdor/Stoneman.

D. Submit markup of architectural plans showing size and location of access panels required for equipment access for approval by Architect.

2.7 IDENTIFICATION MARKERS

A. Mechanical Identification Materials: Provide products of categories and types required for each application as referenced in other Division 22 Sections. Where more than single type is specified for application, selection is installer's option, but provide single selection for each product category. Stencils are not acceptable.

B. Plastic Pipe Markers:

1. Snap-On Type: Provide pre-printed, semi-rigid snap-on, color coded pipe markers, complying with ANSI A13.1 and meeting The University of Oregon Campus Construction Standards.

2. Pressure Sensitive Type: Provide pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1. Secure both ends of markers with color coded adhesive vinyl tape.

3. Insulation: Furnish 1” thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2” beyond each end of plastic pipe marker.

4. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

C. Underground-Type Plastic Line Markers: Provide 6” wide x 4 mils thick multi-ply tape, consisting of solid metallic foil core between 2 layers of plastic tape. Markers to be permanent, bright colored, continuous printed, intended for direct burial service.

D. Valve Tags:

1. Brass Valve Tags: Provide minimum 1 1/2" diameter 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4” high letters and sequenced valve numbers 1/2” high, and with 5/32” hole for fastener. Fill tag engraving with black enamel.

2. Valve Tag Fasteners: Provide solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

3. Access Panel Markers: Provide 1/16” thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8” center hole to allow attachment.

4. Non-potable Water Tags: 1/16” thick, engraved, plastic tags as indicated on Drawings.

E. Plastic Equipment Signs:

1. Provide 4-1/2” x 6” plastic laminate sign, ANSI A.13 color coded with engraved white core lettering.

2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

3. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

a. Name and plan number.

b. Equipment service.

c. Design capacity.

d. Other design parameters, such as pressure drop, entering and leaving conditions, rpm, etc.

F. Acceptable Manufacturers: Craftmark, Seton, Brady, Marking Services, Inc., or Brimar.

2.8 ELECTRICAL

A. General:

1. All electrical material, equipment, and apparatus specified herein shall conform to the requirements of Division 26.

2. Provide all motors for equipment specified herein. Provide motor starters, controllers, and other electrical apparatus and wiring which are required for the operation of the equipment specified herein.

3. Set and align all motors and drives in equipment specified herein.

4. Provide expanded metal or solid sheet metal guards on all V-belt drives to totally enclose the drive on all sides. Provide holes for tachometer readings. Support guards separately from rotating equipment.

5. Provide for all rotating shafts, couplings, etc., a solid sheet metal, inverted "U" cover over the entire length of the exposed shaft and support separately from rotating equipment. Cover shall extend to below the bottom of the shaft and coupling, and shall meet the requirements of the State Industrial Safety Regulations.

6. Specific electrical requirements (i.e., horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.

B. Quality Assurance:

1. Electrical components and materials shall be UL or ETL listed/labeled as suitable for location and use - no exceptions.

C. Motors:

1. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment Specifications.

2. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.

3. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range. Unless otherwise noted on plans, all motors ½ HP or larger shall be rated for 208 or 460 volt, 3-phase, operation. Unless otherwise noted on plans, all motors less than 1/2 HP shall be rated for 120 volt, single phase operation.

4. Temperature Rating: Motor meets class B rise with class F insulation.

5. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.

6. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

   a. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.

   b. VFD driven motors. To be provided rated for inverter duty (NEMA Standard MG-1, Part 31) and equipped with a shaft grounding device or as an insulated bearing motor.

   c. Bearings:

      1) Ball or roller bearings with inner and outer shaft seals.

      2) Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.

      3) Designed to resist thrust loading where belt drives or other drives product lateral or axial thrust in motor.

      4) For fractional horsepower, light duty motors, sleeve type bearings are permitted.

      5) Enclosure Type:

         a) Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.

         b) Guarded drip-proof motors where exposed to contact by employees or building occupants.

         c) Weather protected Type I for outdoor use, Type II where not housed.

   d. Overload Protection: Built-in thermal overload protection where external overload protection is not provided and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.

   e. Noise Rating: "Quiet."

   f. Efficiency:

      1) Motors shall have a minimum efficiency per governing State or Federal codes, whichever is higher.

      2) Motors shall meet the NEMA premium efficiency standard.

g. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

D. Starters and Electrical Devices:

1. Motor Starter Characteristics:

a. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs.

b. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

2. Manual switches shall have pilot lights and all required switch positions for multi-speed motors. Overload Protection: Melting alloy or bi-metallic type thermal overload relays, sized according to actual operating current (field measured).

3. Magnetic Starters:

a. Heavy duty, oil resistant, hand-off-auto (HOA), or as indicated, and pilot lights, properly arranged for single speed or multi-speed operation as indicated.

b. Trip-free thermal overload relays, each phase, sized according to actual operating current (field measured).

c. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.

d. Built-in primary and secondary fused control circuit transformer, supplied from load side of equipment disconnect.

e. Externally operated manual reset.

f. Under-voltage release or protection for all motors over 20 hp.

4. Motor Connections: Liquid tight, flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Low Voltage Control Wiring:

1. General: 14 gauge, Type THHN, color coded, installed in conduit.

2. Manufacturer: General Cable Corp., Alcan Cable, American Insulated Wire Corp., Senator Wire and Cable Co., or Southwire Co.

F. Disconnect Switches:

1. Fusible Switches: For equipment 1/2 HP or larger, provide fused, each phase; heavy duty; horsepower rated; spring loaded quick-make, quick-break mechanism; dead front line side

shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity and characteristics as indicated.

2. Non-Fusible Switches: For equipment less than 1/2 horsepower, switch shall be horsepower rated; toggle switch type with thermal overload quantity of poles and voltage rating as required.

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal or otherwise irregular work, unless so indicated on Drawings or approved by Architect.

3.2 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

3.3 INSTALLATION

A. Coordinate the work between the various Plumbing Sections and with the work specified under other Divisions. If any cooperative work must be altered due to lack of proper supervision or failure to make proper and timely provisions, the alternations shall be made to the satisfaction of the Engineer and at the Contractor’s cost.

B. Inspect all material, equipment, and apparatus upon delivery and do not install any damaged or defected materials.

C. Penetrations through acoustically significant construction shall be sealed airtight in accordance with Resiliently Sealed Penetration Details and Section 079219 – Acoustical Joint Sealants. Escutcheons shall not be used at acoustically significant penetrations so that resilient seals can be observed.”

3.4 SUPPORTS AND HANGERS

A. Prior to installation of hangers, supports, anchors, and associated work, installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives, (if any), installers of other work with requirements specified.

B. Seismic restraints installed at vibration isolated equipment, ductwork, and/or piping shall not support gravity loads

C. Installation of Building Attachments: Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed. Fasten insert securely to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through opening at top of inserts.

D. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors, and other building structural attachments.

E. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

F. Install hangers within 12 inches of every change in piping direction, end of pipe run or concentrated load, and within 36 inches of every major piece of equipment. Hangers shall be installed on both sides of flexible connections. Where flexible connection connects directly to a piece of equipment only one hanger is required.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

H. Support gas independently of other piping.

I. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

J. Hanger Spacing in accordance with following minimum schedules (other spacings and rod sizes may be used in accordance with the SMACNA Seismic Restraint Manual using a safety factor of five):

1. Copper Pipe:

Pipe Size	Max. Hanger Spacing	Rod Size
1/2" to 2"	6 feet	3/8"
2 ½" and larger	8 feet	1/2"

K. Sloping, Air Venting, and Draining:

1. Slope all piping as specified and as indicated, true to line and grade, and free of traps and air pockets. Unless indicated otherwise, slope piping in the direction of flow as follows:

Service	Inclination	Slope
Domestic Water	Down	1" per 100'
Soil and Waste	Down	1/4" per foot (1/8" per foot)
Storm Water	Down	1/4" per foot (1/8" per foot)
Sanitary Vent	Up (towards roof terminal)	1/4" per foot (1/8" per foot)

2. Provide drain valves and hose adapters at all low points in piping.

3. Provide vents at all high points in water piping.

L. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connecting equipment.

3. Insulated Piping: Comply with the following installation requirements:

   a. Clamps: Attach clamps, including spacers, (if any), to piping with clamps projecting through insulation.

   b. Shields: Where low compressive strength insulation or vapor barriers are indicated on cold water piping, install shields or inserts.

   c. Saddles: Where insulation without vapor barrier is indicated install protection saddles.

M. Installation of Anchors:

1. Install anchors at proper locations to prevent excessive stresses and to prevent transfer of loading and stresses to connected equipment.

2. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure.

3. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

4. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends.

N. Equipment Supports:

1. Provide all concrete bases, unless otherwise furnished as work of Division 03. Furnish to Division 03 Contractor scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories necessary for base construction.

2. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks.

O. Adjusting:

1. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

2. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

3. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 ROOF CURBS, EQUIPMENT RAILS, PIPE PORTALS

A. Install per manufacturer's instructions.

B. Coordinate with other trades so units are installed when roofing is being installed.

C. Verify roof insulation thickness and adjust raise of cant to match.

D. Plumbing equipment and piping shall be vibration isolated in accordance with Section 220548 – Vibration Isolation of Plumbing Systems.

E. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

F. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

G. Flexible Pipe Connectors: Install on equipment side of shutoff valves.

3.6 ELECTRICAL REQUIREMENTS

A. Plumbing Contractor shall coordinate with Division 26 work to provide complete systems as required to operate all mechanical devices installed under this Division of work.

B. Installation of Electrical Connections: Furnish, install, and wire (except as may be otherwise indicated) all plumbing, motors and controls in accordance with the following schedule and in accordance with equipment manufacturer’s written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA’s “Standard of

Installation" to ensure that products fulfill requirements. Carefully coordinate with work performed under the Plumbing Division of these Specifications.

C. Division 22 has responsibilities for electrically powered or controlled plumbing equipment which is specified in Division 22 Specifications or scheduled on Division 22 Drawings. The specific division of responsibilities between Division 22 and 26 for furnishing or wiring this equipment is as follows:

1. Division 22 Plumbing Responsibilities:

a. MOTORS: Furnish and install all motors necessary for plumbing equipment.

b. MAGNETIC STARTERS: Furnish all magnetic starters whether manually or automatically controlled which are necessary for mechanical equipment. Furnish these starters with all control relays or transformers necessary to interface with plumbing controls. If the starter is factory installed on a piece of Division 22 equipment, also furnish and install the power wiring between starter and motor.

c. VARIABLE FREQUENCY DRIVES: Provide all VFD's associated with plumbing equipment. If the drive is installed on a piece of factory assembled equipment the wiring between motor and drive is to be provided as part of the factory equipment.

d. DISCONNECTS: Provide the disconnects which are part of factory wired Division 22 plumbing equipment. Factory wiring to include wiring between motor and disconnect or combination starter/disconnect.

e. CONTROLS: Division 22 Contractor (including the temperature controls installer) is responsible for the following equipment in its entirety. This equipment includes but is not limited to the following:

1) Control relays necessary for controlling Division 22 equipment.

2) Control transformers necessary for providing power to controls for Division 22 equipment.

3) Low or non-load voltage control components.

4) Non-life safety related valve.

5) Solenoid valves, EP and PE switches.

D. Division 26 has responsibilities for electrically powered or controlled equipment which is specified in Division 22 Specifications or scheduled on Division 22 Drawings. The specific division of responsibilities between Division 22 and 26 for furnishing or wiring this equipment is as follows:

1. Division 26 Electrical Responsibilities:

a. MOTORS: Provide the power wiring for the motors.

b. MAGNETIC STARTERS: Except where magnetic starters are factory installed on Division 22 factory assembled equipment, Division 26 is to install magnetic starters furnished by Division 22 and install the necessary power wiring to the starter and from the starter to the motor. In the case of factory installed starters, Division 26 is to install the necessary power wiring to the starter.

c. VARIABLE FREQUENCY DRIVES: Physically mount all VFD's, which are not specified to be installed on Division 22 factory assembled equipment. Provide the necessary power wiring to the VFD and from the VFD to the motor except in the case of factory installed VFD's where wiring between the motor and VFD is to be by Division 22. Where disconnects are installed between a VFD and a motor provide the interlocking wiring between the disconnect and VFD to insure that the drive is shutdown simultaneously with motor.

d. DISCONNECTS: Provide all disconnects necessary for Division 22 mechanical equipment which are not provided as part of factory wired Division 22 equipment. Provide power wiring to all disconnects. In addition provide power wiring between motor and disconnect when the disconnect is not factory installed. See also Variable Frequency Drive above for special wiring requirements.

e. CONTROLS: Division 26 Contractor is responsible for providing power to control panels and control circuit outlets.

E. Motors and Motor Control Equipment: Conform to the standards of the NEMA. Equip motors with magnetic or manual line starters with overload protection. Motor starters and line voltage controls shall be installed under Electrical Section but located and coordinated as required under this Section of the work. Starters shall be combination type with non-fusible disconnect switches. All single phase fractional horsepower motors shall have built-in overload protection.

3.7 PAINTING

A. All painting shall be provided under this Division work, unless otherwise specified under Division 9: Painting. Painting schemes shall comply with ANSI A13.1. Paint all exposed materials such as piping, equipment, insulation, steel, etc. Exposed gas piping inside and outside the building shall be painted with two coats of "Rust-O-Leum" Yellow. Exposed copper indirect waste piping serving food service equipment shall be painted metallic chrome.

B. All exposed work under Division 22 shall receive either a factory finish or a field prime coat finish, except:

1. Exposed copper piping.

2. Aluminum jacketed outdoor insulated piping.

3.8 IDENTIFICATION MARKERS

A. General: Follow University of Oregon Campus Construction Standards for all labeling. Refer to 22 00 00 Item 20 for details. Where identification is to be applied to surfaces which require insulation, painting, or other covering or finish, including valve tags in finished mechanical

spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Piping System Identification:

1. Install pipe markers on each system, and include arrows to show normal direction of flow.

2. Locate pipe markers as follows:

a. Near each valve and control device.

b. Near each branch, excluding short take-offs for fixtures; mark each pipe at branch, where there could be question of flow pattern.

c. Both sides where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

d. At access doors, manholes, and similar access points which permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

f. Spaced horizontally at maximum spacing of 20' along each piping run, with minimum of one in each room. Vertically spaced at each story transversed.

C. Underground Piping Identification: During backfilling/topsoiling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6” to 8” below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16”, install single line marker.

D. Plumbing Equipment Identification: Locate engraved plastic laminate signs on or near each major item of plumbing equipment and each operational device. Provide signs for the following:

1. Main control and operating valves, including safety devices. Provide brass tags with valve number, building area served, valve status (normally open, normally closed), system served.

2. Meters, gauges, thermometers, and similar units.

3. Pumps, compressors and similar motor-driven units.

4. Hot water system mixing valves and similar equipment.

5. Boilers, heat exchangers and similar equipment.

6. Tanks and pressure vessels.

7. Strainers, filters, treatment systems and similar equipment.

E. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations. Equipment signs shall include an identification of the area or other equipment served by the equipment being labeled.

F. Gas pressure regulators shall have metal tags attached stating, "Warning: 2 lbs. upstream natural gas pressure. Do not remove."

3.9 VIBRATION AND DYNAMIC BALANCING

A. Vibration tolerances shall be as specified by the "International Research and Development Corporation", Worthington, Ohio, measured by the displacement, peak to peak, as follows:

1. Pump and Electric Motors: Below severity chart labeled "SLIGHTLY ROUGH", maximum vibration velocity of 0.157 in/sec, peak.

2. Compressors: Same as pumps.

B. Correction shall be made to all equipment which exceeds vibration tolerances specified above. Final vibration levels shall be reported as described above.

3.10 TESTING

A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Architect, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

END OF SECTION

PLUMBING

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 220500 - Basic Materials and Methods, and other Sections in Division 22 specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 220500: Basic Materials and Methods

B. Section 220700: Plumbing Insulation

C. Section 222113: Plumbing Piping, Valves and Specialties

D. Section 224000: Plumbing Fixtures

E. Section 221123: Plumbing Equipment

1.3 SCOPE

A. Systems as specified under this section shall include but not necessarily be limited to the following:

1. Connection of all waste, vent, and water piping to all plumbing fixtures, drinking fountains, sinks, drains and mechanical equipment.

2. Provide for future expansion as indicated.

3. Connect to new mechanical equipment including chiller, cooling tower expansion tanks, domestic water heaters, and boilers, etc.

4. Connect hot and/or cold water to hose bibs and wall hydrants. Provide individual shut-off valves at each location.

5. Provide reduced pressure type backflow preventer assembly on connection to chillers expansion tanks, and cooling towers as indicated.

6. Provide traps on all floor drains with trap primer where specified. Pipe to trap shall be ½" minimum.

7. Domestic water heating plant shall be electric supply.

8. Provide domestic hot water recirculation system. Each branch line to be set at one (1) gpm. Provide individual shut-off valve, check valve and ball valve with memory stop at each location.

9. Provide floor drainage in core toilets, mechanical rooms and equipment rooms.

10. Provide connections for all area drains, catch basins, downspouts, roof drains and overflow drains to storm sewer system.

11. Temporary Water Service: As directed by the General Contractor, the plumber shall provide a temporary metered water service and temporary water risers with four (4) hose bibbs installed at each level as the building proceeds upwards to the roof.

1.4 SUBMITTALS

A. Prior to construction submit for approval all materials and equipment in accordance with Division 01. Submit manufacturer's data, installation instructions, and maintenance and operating instructions for all components of this section including, but not limited to, the following:

1. Plumbing specialties.

2. Trap primers.

3. Cleanouts.

4. Drains

5. Wall hydrants and hose bibbs

6. Mixing valves

B. Contractor shall submit a letter that all products used in the plumbing installed are certified for use in the State of Oregon.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products against dirt, water, chemical, and mechanical damage. Do not install damaged products - remove from project site.

1.6 WARRANTY

A. Provide one-year (12 months) warranty. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory authorized service.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment under this Division of the Specifications shall be new, of best grade and as listed in printed catalogs of the manufacturer.

B. All manufactured materials shall be delivered and stored in their original containers. Equipment shall be clearly marked or stamped with the manufacturer's name and rating.

C. The following products to be included as part of this work but specified under Section 220500 Basic Materials and Methods and Section 222113 Plumbing Piping, Valves and Specialties:

1. Piping.

2. Valves.

3. Hangers and supports.

4. Escutcheon plates, flashings, and sleeves.

5. Identification markers and signs.

6. Anchors and alignment guides to comply with seismic requirements as indicated on structural plans.

7. Excavation and backfill.

8. Pressure and temperature gauges.

9. Access Panels.

D. Plumbing Fixtures: Refer to Section 224000.

E. Plumbing Equipment: Refer to Section 221123.

F. Products made of, or containing, lead, asbestos, mercury, or other known toxic or hazardous materials are not acceptable for installation under this Section. Any such products installed as part of the work of this Section shall be removed and replaced and all costs for removal and replacement shall be borne solely by the Contractor(s).

2.2 VALVES: DOMESTIC WATER (SEE SECTION 222113)

2.3 CLEANOUTS

A. Cleanout Plugs: Bronze, taper thread countersunk head.

B. Floor Cleanouts: Service weight cast-iron body and frame, flange with flashing clamp, adjustable cast-iron collar, caulk inside, Ty-seal or No-hub joints, neoprene plug gasket seal.

1. Carpeted Areas: Zurn ZN-1400-KC-VP-BP-CM or J. R. Smith 4028 C - F- C - Y - U

2. Tiled Areas: Zurn ZN-1400-X-KC-VP-BP or J.R. Smith 4148 - F - C - U

3. Unfinished Areas: Zurn ZN-1400-HD-KC-VP-BP or J.R. Smith 4108 C - F - C - U

4. Yard Areas: Zurn Z 1474-IN-VP or J.R. Smith 4258 - C - U

C. Cleanout Tee: Cast iron cleanout tee with countersunk brass plug, neoprene plug gasket seal and smooth stainless steel cover.

1. Manufacturer: Zurn Z-1446-BP or J. R. Smith 4532 S (Y)

2.4 ROOF FLASHING

A. Flashing: Unless indicated otherwise on the drawings flashings for pipes through the roof shall be galvanized sheet metal, 24 gauge minimum with seams and joints lapped and soldered watertight. Coordinate with Architectural Sections for flashings and roofing.

B. Vent Pipes: preformed vinyl/galvanized steel assembly.

2.5 WATER HAMMER ARRESTORS

A. Piston Type: Hard drawn copper construction, mirror finished internal surfaces; machine finished brass piston, air charged, 250 psi rated, tested and certified per PDI WH-201 and ASSE

1. Manufacturer: Watts Series 15, Precision Plumbing series SC, or Sioux Chief.

2.6 ANTI-CONTAMINATION WALL HYDRANTS AND HOSE BIBBS

A. Anti-contamination Hose Bibs, HB-1: Bronze body construction, polished chrome plated finish, renewable composition disc, wheel handle, ½" NPT inlet, 3/4" threaded hose end, vacuum breaker/backflow preventer, ANSI 1011.

1. Manufacturer: Zurn Z1341 or J.R. Smith.

B. Anti-Contamination Wall Hydrant, WH-1: Exterior, box-type, freezeproof, cast-bronze construction, chrome plated finish, loose key, bronze casing, length to suit wall thickness, vacuum breaker/backflow preventer, 1/2" threaded inlet, 3/4" threaded hose end, solder joint.

1. Manufacturer: J.R. Smith 5509QT or Zurn.

2.7 DRAINS

A. General: Provide drains of type and size as indicated on drawings, including features, as specified herein.

1. Acceptable Manufacturers: J.R. Smith, Zurn, Wade, Sioux Chief, Josam and Watts.

B. Floor Drain, FD-1 - Finished Areas:

1. Enamel coated cast iron body with flange, integral reversible clamping collar, seepage openings, adjustable round satin nickel bronze strainer, sediment bucket, bottom outlet, caulk inside or Ty-Seal or no-hub joint. Provide trap primer.

a. Manufacturer: Zurn ZN-415-5B-Y-P or J.R. Smith 2010 - A - C(Y).

C. Floor Drain, FD-2 - Mechanical Rooms:

1. Enamel coated cast iron body with flange, clamping collar, seepage openings, 8-1/2" diameter adjustable cast iron bar strainer, sediment bucket, bottom outlet, caulk inside or Ty-Seal or no-hub joint. Provide trap primer.

a. Manufacturer: Zurn Z-520-Y-P or J.R. Smith 2350 C(Y).

D. Floor Sink, FS-1:

1. Enamel coated cast iron body with seepage flange, acid resistant interior surfaces, aluminum dome strainer, 12" x 12" x 6", half grate, bottom outlet, caulk inside, Ty-Seal or no-hub joint. Provide trap primer.

a. Manufacturer: Commercial Enameling series 906-1 or Zurn-ZFD-2375-K-H-Y.

E. Roof Drain, RD-1:

1. 16" diameter, enamel coated cast iron body with flange, flashing ring with gravel stop, under deck clamp, extension, sump receiver, 10 7/8" aluminum mushroom domes, caulk inside, Ty-Seal or no hub joint.

a. Manufacturer: J.R. Smith 1010 - C(Y) - C - R - CL - AD - AD or Zurn ZA-100-C-R.

F. Overflow Roof Drain, OD-1:

1. 16"diameter, Enamel coated cast iron body with flange, flashing ring with gravel stop, underdeck clamp, extension, sump receiver, standpipe collar, aluminum dome, caulk inside, Ty-Seal or no-hub joint.

a. Manufacturer: J.R. Smith 1070-C(Y)-C-R-E-CL-AD or Zurn ZA-100-W2-DP.

G. Downspout Fitting, DSN-1:

1. Cast bronze body construction and flange, satin bronze finish, threaded outlet.

a. Manufacturer: Zurn Z-199, Watts RD-940 or J.R. Smith 1770.

2.8 TRAP PRIMER

A. Cast bronze construction, vacuum breaker, ½" sweat solder connection. Install in accessible location or provide access panel.

1. TP-1: PPP Prime Time electronic trap primer Series PT. Coordinate 120 V, electrical service with Division 26.

2.9 MIXING VALVES ASSEMBLY

A. Mixing Valve: 300 psi, Brass construction, thermostatic controller with check stops. Refer to drawings for schedule of each valve. Use high/low type for uses over 20 gpm.

B. Manufacturer: Lawler, Symmons or Leonard.

PART 3 - EXECUTION

3.1 GENERAL

A. This system to be installed by an experienced firm regularly engaged in the installation of plumbing systems as specified by the requirements of the Specifications.

B. Install all items specified in this section of the Specification under the full purview of local and state governing agencies.

C. Refer to Section 220500: General Plumbing Requirements for installation of piping, valves and other requirements.

3.2 PERFORMANCE OF WORK

A. Examine areas, physical conditions and phasing requirements under which materials are to be installed. Layout the system to suit the different types of construction and equipment as indicated on the drawings.

B. Work shall start immediately after authorization has been given to proceed so that the overall progress of the construction is not delayed. No foundry items to be installed until submittals have been approved.

C. Coordinate with other trades as necessary to properly interface components of the plumbing system.

D. Follow manufacturer's directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the drawings or covered in these Specifications.

E. The omission from the drawings or Specifications of any details of construction, installation, materials, or essential specialties shall not relieve the Contractor from furnishing the same in place for a complete system.

3.3 PIPING INSTALLATION

A. The word “piping” shall mean all pipes, fittings, nipples, valves and all accessories connected thereto.

B. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts flues, conduits and

work of other trades and close to ceiling or other construction as practical, free of unnecessary traps or bends.

C. Run horizontal sanitary drainage at uniform pitch of not less than 1/8" per foot, unless otherwise indicated. Pitch horizontal vent piping downward from stack to fixtures.

D. Run drainage piping as straight as possible with long radius turns. Offsets shall be made at an angle of 45° or less.

E. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.

F. Piping connections to all equipment shall be made up with unions.

G. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.

H. Use reducers or increasers. Use no bushings.

I. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageway.

J. Vent pipes to terminate at least 6" above the roof.

K. Cover, cap or otherwise protect open ends of all piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect water supply piping as specified.

L. Exposed connections to equipment shall be installed with special care, showing no tool marks or threads at fittings and piping. No bowed or bend piping to be permitted.

M. All ferrous to non-ferrous connections shall be made by means of dielectric fittings. Submit shop drawings for approval.

N. Use extra heavy pipe for nipples, where unthreaded portion is less than 1½”. Use no close nipples. Use only shoulder nipples.

O. All piping shall be inspected for defects and flaws prior to installation. Remove any damaged piping from job site. Piping shall be thoroughly cleaned of dirt, debris or rust.

P. Cleanouts to be provided at each change in direction greater than 135° or 100' maximum intervals on underground piping.

Q. Revise existing cleanout elevations to be flush with new floor elevation.

R. Cleanouts to be same size as pipe except cleanout plugs larger than 4" shall not be required.

S. Cleanouts on concealed piping to be extended through and terminate flush with the finished wall or floor. Cover plates to be provided on all cleanout plugs in finished areas.

T. The bodies of cleanout ferrules to conform in thickness to that required for pipe and fittings of the same metal.

U. Route piping on roof on manufactured polypropylene pipe supports: Roof Top Blox RTB-# or Caddy system.

3.4 WATER HAMMER ARRESTERS

A. Install as per PDI Standard WH-20 and equipment manufacturer's recommendation and as shown on working drawings. Provide before each quick closing valve (flush valve, solenoid valve, etc.) or bank of fixtures.

B. Install at each plumbing fixture, bank of fixtures, equipment and as indicated.

3.5 TESTING AND DISINFECTING - PLUMBING SYSTEMS

A. General: The Contractor to perform all field tests and provide all labor, equipment, and incidentals required for the tests. Owner to witness all field tests and conduct all field inspections. The Contractor to give the Owner ample notice of the dates and times scheduled for tests. Any deficiencies to be completely retested at no additional cost.

1. Inspection: Inspection to continue during installation and testing. Perform a final inspection of the equipment prior to installation to determine conformity to the type, class, grade, size, capacity, and other characteristics specified herein or indicated. Correct or replace all rejected equipment prior to installation.

2. Water Distribution Piping Test: Before fixtures are set, subject the entire hot and cold piping system to a hydrostatic pressure test of 150 pounds per square inch with water for not less than 8 hours in order to permit inspection of all joints with no evidence of leakage. Where a portion of the water distribution piping is to be concealed before completion, test this portion separately as specified for the entire system.

3. Sanitary, Waste, Storm, Rainwater, and Vent Piping Test: Before the installation of any fixtures or drains, cap the ends of the system and fill all lines with water to the roof level and allow to stand for at least 30 minutes without leakage. Make tests within building with piping exposed. If the system is tested in sections, tightly lug each opening, except the highest opening of the section under test, and fill each section with water and test with at least a 10' head of water.

4. Sanitary Drainage Vent, Storm, Rainwater and Fixture System Final Test: Give sanitary, drainage vent, and fixture systems an in-service test after complete installation. After all fixtures are installed, test the entire vent and sewer system and prove gas and water tight. Final test shall be with air. Before proceeding with test, fill all traps with water. Close all stacks and line openings during test, for a minimum period of 24 hours. If test reveals leakage of air at any point, repair and retest the system.

5. Disinfection of Water Distribution System: After pressure tests have been made thoroughly flush the entire domestic water distribution system with water until all entrained dirt and mud have been removed, and sterilize by chlorinating material. The chlorinating material shall be liquid chlorine. The chlorinating material shall provide a dosage of not less than 50 parts per million and shall be introduced into the system or part thereof in an approved manner. Retain the treated water in the pipe for 24 hours, or, fill

the system or part thereof with a water-chlorine solution containing at least 200 parts per million of chlorine and allow to stand for three hours. Open and close all valves in the system being disinfected three times during the contact period. Then flush the system with clean potable water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period open and close all valves and faucets three times. From at least three divergent points in the system, take samples of water in properly sterilized containers for bacterial examination. Repeat the disinfecting until tests indicate that satisfactory bacteriological results have been obtained.

a. Taking of samples shall be witnessed by Architect or Owner's representative. Samples are to be taken and tested by an independent analytical testing laboratory. Written reports shall be supplied to Architect for approval.

3.6 OPERATING TESTING AND CERTIFICATION - PLUMBING SYSTEMS

A. Upon completion and disinfection, and prior to acceptance of the installation, the Contractor to subject the plumbing system to operating tests to demonstrate satisfactory, functional, and operating efficiency. Such operating tests to include the following information in a report with conclusions as to the adequacy of the system.

1. Time, date, and duration of tests.

2. Water pressures at most remote location.

3. Operation of all valves and hydrants.

4. Operation of all floor drains by flooding with water.

5. Quality of domestic water.

6. Read all indicating instruments at half-hour intervals unless otherwise directed. Supply four copies of the test report to the Owner.

3.7 CLEANING EQUIPMENT AND MATERIALS

A. In addition to the requirements of Section 220500, provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care to be taken to provide protection for bearings, open connections, pipe coils, pumps, compressors, and similar equipment.

B. All piping, finished surfaces, and equipment to have all grease, adhesive labels, and foreign materials removed.

C. All piping to be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, flush valves, and similar items shall be thoroughly cleaned. Remove and thoroughly clean and reinstall all liquid strainer screens after the system has been in operation for ten days.

D. When connections are to be made to existing systems, the Contractor is to do all cleaning and purging of the existing systems required to restore them to the condition existing prior to the start of work.

3.8 OPERATION MANUALS, START-UP SERVICE, WARRANTIES, ACCEPTANCE AND GUARANTEES

A. General: Refer to Section 220500 for details.

END OF SECTION

VIBRATION ISOLATION OF PLUMBING SYSTEMS

PART 1 GENERAL

1.1 SCOPE

A. Certain systems and components of the project are intentionally designed to avoid vibration problems. Vibration isolation systems are more critical than “standard construction.” The Contractor is cautioned not to overlook these specific components in favor of “standard construction practices” in any pricing, submittal, or construction procedure.

1. Mount rotating and/or reciprocating equipment on vibration isolators as noted in the Contract Documents. Select, install and adjust isolators to prevent the transmission of objectionable vibration and noise to the building structure.

1.2 RELATED WORK

A. Perform work described in other Specification Sections to meet the product and execution requirements of this Specification.

1. Division 1 – General Requirements.

2. Section 01 86 36 – Ambient Noise Performance Requirements.

3. Division 3 – Concrete.

4. All Division 22 specifications relating to vibration isolated equipment and materials.

5. Section 26 05 48 – Vibration Isolation of Electrical Systems.

1.3 QUALITY ASSURANCE

A. Provide vibration isolators for Divisions 22, 23, 26, 27 from the product line of a single manufacturer unless approved by the project Acoustics Consultant. **Isolators not supplied by the primary vibration isolator manufacturer will be rejected.**

B. The vibration isolator manufacturer's representative shall determine isolator sizes and mountings, and shall provide field supervision and inspection to assure proper installation, adjustment and performance. Representative shall alert the Engineer and project Acoustics Consultant to any isolator selections, which may experience resonance with the approved equipment and upgrade any isolators that are found to resonate with the supported equipment. The Contractor shall include in his bid vibration isolation system elements as recommended by the manufacturer's representative to make a complete, correct, and safe installation. Supply and install any incidental materials needed, even if not explicitly specified or shown in the Contract Documents, without claim for additional payment.

C. A licensed professional engineer, in the employ of the vibration isolation manufacturer, shall certify and stamp the shop drawings stating that all requirements of state and local codes have been met.

1.4 SUBMITTALS

A. Vibration Isolation Hangers: In a single consolidated submittal, provide catalog datasheets, shop drawings and other documents as necessary to indicate equipment unit number, isolator type, supported weight, scheduled deflection, **proposed deflection under operating load**, spring free height, spring operating height, spring solid height (at coil bind), and spring diameter for each isolator. **Partial and/or incomplete submittals will be rejected**. Indicate the weight and lowest rotational or reciprocal speed of each piece of isolated equipment. Indicate bridge bearing quality and durometer for elastomers where provided. Use the format below to summarize isolator characteristics for submittal review by the Engineer and project Acoustics Consultant.

B. **SAMPLE SUBMITTAL FORMAT:**

	HANGER
Supported Equipment	P-1
Isolator Type	Mason 30N-B-410
Supported Weight	375 LB
Lowest Speed	1500 RPM
Scheduled Deflection	0.75 inch
Operating Deflection	**0.97 inch**
Spring Free Height	3.75 inch
Operating Height	2.78 inch
Solid Height	1.62 inch
Spring Diameter	4.00 inch
Remarks	-

C. Shop Drawings: Submit shop drawings and manufacturer's installation instructions for thrust restraints and sway braces wherever they are required.

D. Inspection Report: Upon completion of the installation and after the system is put into operation, the manufacturer's representative shall make a final inspection and submit his report to the Architect and Engineer in writing certifying the correctness of installation and compliance with approved submittal data. The Contractor shall allow for the cost of this service in his bid.

1.5 DRAWINGS ARE SCHEMATIC ONLY

A. Choose the size and number of hangers to meet the requirements of this Specification. Provide brackets, rails, bases, braces, snubbers, etc. as needed for a complete and correct installation.

1.6 STANDARDS

A. American Association of State Highway and Transportation Officials Standard Specifications for Highway Bridges (AASHTO), Highway Bridge Specification. See Table B requirements for physical properties of bridge-bearing quality elastomers.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION MANUFACTURERS

A. The following vibration isolation manufacturers will be approved providing mounting systems are in strict accordance with design intent as specified herein:

1. Mason Industries, Inc., Hauppauge, New York.

2. Kinetics Noise Control, Dublin, Ohio.

3. The VMC Group / Amber-Booth Company, Inc., Houston, Texas.

4. The VMC Group / Korfund Dynamics, Bloomingdale, NJ.

B. Since manufacturers' products vary, specific models listed in this Specification may not be approved if they do not meet all requirements in this Specification. Model designations listed herein are intended only as a guide.

2.2 SPRING REQUIREMENTS

A. All steel springs as installed shall have a minimum additional travel to solid (coil bind) equal to 50% of the deflection under operating load.

B. Spring diameter shall be no less than 80% of the compressed height of the spring at operational load.

C. Steel springs shall not take a permanent set when compressed to coil bind.

D. Steel springs shall be color coded to allow positive identification after installation.

2.3 CORROSION RESISTANCE

A. All isolators and associated hardware shall be designed or treated for resistance to corrosion.

2.4 ELASTOMER REQUIREMENTS

A. All elastomeric (rubber, neoprene) components shall be selected for lowest durometer available, Shore A rating. Hardness shall not exceed 50 durometer, Shore A rating, unless approved by project Acoustics Consultant. Use bridge-bearing quality rubber or neoprene meeting AASHTO Highway Bridge Specifications in all elastomeric components.

2.5 TYPE G: SPRING AND ELASTOMER-IN-SERIES ISOLATOR HANGERS

A. Spring and elastomer in series isolator hangers shall contain a spring and elastomer in series. The diameters of the spring and the hole in the hanger box shall allow for 15-degree misalignment from vertical before mechanical short circuit occurs. Mason model 30N or DNHS, Kinetics model SRH, Amber-Booth model BSRA, Korfund model RSH.

2.6 TYPE K: SWAY BRACES

A. Sway braces shall be in sets of two or more and shall consist of aircraft cable, elastomers, or elastomer and spring assemblies. Braces shall keep the equipment stable without restricting the free motion of the vibration isolators.

2.7 ELASTOMERIC FLEXIBLE PIPING CONNECTORS

A. Elastomeric flexible piping connectors shall be twin spherical type or single sphere type (only where required for small pipe sizes) and shall be manufactured of cord reinforcing and elastomeric covers. Connectors shall be able to accept elongation, compression and axial and transverse movement. Connectors shall be selected to suit the system temperature, pressure and fluid type. No control rods or cables shall be used to control extension of the connector Mason models SFDEJ, SFU; Kinetics models FTC, UTC; Amber-Booth models 2600, 2655; Korfund model VMT.

2.8 FLEXIBLE CONDUIT

A. Refer to Section 26 05 48: Vibration Isolation of Electrical Systems.

2.9 VIBRATION ISOLATION TABLE (TABLE 1)

A. Vibration isolation for all equipment shall be provided in accordance with the following Table 1, within rated capacities of isolators, except as otherwise noted in Part 3 of this Specification.

TABLE 1: VIBRATION ISOLATION TABLE

EQUIPMENT TAG	BASE TYPE	ISOLATOR TYPE	MIN. OPERATING DEFLECTION (IN.)
CP-1	-	G	0.75

PART 3 EXECUTION

3.1 GENERAL

A. Resiliently suspend equipment from approved supports, with isolation hangers as specified herein and as shown on the Contract Documents. Install seismic restraints in strict conformance with the certified shop drawings. Select locations of isolation equipment for ease of inspection and adjustment as well as for proper operation. Contractor shall cooperate with the Architect,

Engineer, and project Acoustics Consultant to replace, at no additional cost to the Owner, any isolators that need to be upgraded from what is shown on the Contract Documents if equipment operation results in resonance with building natural frequencies.

3.2 HANGERS

A. Align vibration isolators squarely above or below mounting points of the supported equipment.

B. Position vibration isolation hangers as high as possible in the hanger rod assembly **but not in contact with the building structure.** Provide 1” minimum to 3” maximum clearance between hanger housing and structure above. Provide side clearance for hanger housings to allow a full 360-degree rotation about the rod axis without contacting any object.

C. Limit stops shall be out of contact during normal operation.

D. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting pipes.

E. Isolators supporting equipment with center of gravity that is asymmetrical in plan shall be selected for nearly equal deflection under actual load.

F. Install isolators in accordance with manufacturer's instructions.

3.3 ISOLATED SYSTEMS SHALL BE INDEPENDENT

A. Do not hang or support piping, ductwork, conduit or equipment on other equipment, pipes or ductwork installed on vibration isolators. Maintain 2” clearance between isolated equipment and walls, ceilings and other equipment.

3.4 STABILIZE ALL ISOLATED EQUIPMENT

A. Provide resilient sway bracing to solid anchor points to stabilize all resiliently supported equipment and piping in accordance with all requirements of state and local codes.

3.5 TREAT ALL ISOLATION SYSTEMS FOR CORROSION RESISTANCE

A. Repair coatings damaged during installation.

3.6 FLEXIBLE PIPING CONNECTORS

A. Provide elastomeric flexible piping connectors in all piping where it is connected to equipment that requires vibration isolation per this Specification. Install these connectors between the equipment and the first associated pipe support or hanger, except where supports connect to an inertia base common to the equipment. Follow manufacturer's instructions for proper installation of flexible connectors including pre-extension of twin-sphere type. Install connectors in easily visible locations for inspection and replacement purposes.

3.7 PIPING

A. The installation or use of vibration isolators shall not cause any change of position of piping which will result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, maintain equipment and piping in a rigid position during installation. Do not transfer the load to the isolators until the installation is complete and under full operational load.

3.8 FLEXIBLE CONDUIT

A. Use to isolate vibration from all equipment requiring vibration isolation per this Specification. Refer to Section 26 05 48: Vibration Isolation for Electrical Systems for installation requirements.

END OF SECTION

PLUMBING INSULATION

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 220500 - Basic Materials and Methods, and other Sections in Division 22 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall include, but not necessarily be limited to, providing insulation for the following:

1. Piping:

    a. Domestic hot water supply and return.

    b. Domestic cold water.

    c. Horizontal roof and overflow drain piping.

    d. Underground water piping.

    e. Horizontal pipe runs from fixtures receiving cold condensate.

    f. All valves, separators, strainers and fittings for systems listed above.

2. Hot and Cold Equipment:

    a. Hot water storage tanks.

3. Drains:

    a. All roof and overflow drain bodies.

B. Types of mechanical insulation specified in this Section include the following:

1. Fiberglass pipe insulation.

2. Cellular glass pipe insulation.

3. Calcium silicate pipe insulation.

4. Flexible elastomeric closed cell insulation

5. Insulation jackets.

6. Insulation accessories.

7. Fiberglass equipment insulation.

8. Calcium silicate equipment insulation.

9. Cellular glass equipment insulation.

10. Flexible unicellular equipment insulation.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 220500: Basic Materials and Methods.

B. Section 220501: Plumbing.

1.4 DEFINITIONS

A. Ambient: The air temperature to be maintained in a conditioned room. Typically between 70°F and 78°F.

B. Insert: Spacer placed between the pipe support system and the piping to allow for the space required for insulation.

C. Insulation Group (IG): Definition of Insulation Materials and Operating Temperatures.

D. Insulation Shield: Buffer material placed between the pipe support system and the insulation to prevent the insulation material from crushing.

E. Jacket: Protective covering over the pipe insulation; may be factory applied such as "all service jacket" or field applied to provide additional protection; of such materials as canvas, PVC, aluminum or stainless steel.

F. Piping Insulation: Thermal insulation applied to prevent heat transmission to or from a piping system.

G. Vapor Barrier Jacket: Insulation jacket material that impedes the transmission of water vapor.

H. Freezing Climate: Where outdoor design temperature is less than 33^{o} F, as stated in ASHRAE fundamentals under 99% column for winter design conditions.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:

1. American Society for Testing and Materials (ASTM): Manufacture and test insulation in accordance with the ASTM Standards, including:

a. B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plat.

b. C165 - Recommended Practice for Measuring Compressive Properties of Thermal Insulation.

c. C167 - Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.

d. C177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission.

e. Properties by Means of the Guarded-Hot-Plate Apparatus.

f. C195 - Specification for Mineral Fiber Thermal Insulating Cement.

g. C196 - Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement.

h. C302 - Test Method for Density of Preformed Pipe-Covering-Type Thermal Insulation.

i. C303 - Test Method for Density of Preformed Block-Type Thermal Insulation.

j. C305 - Test for Thermal Conductivity of Pipe Insulation.

k. C356 - Test for Linear Shrinkage of Preformed High-Temperature Thermal Insulation.

l. C411 - Test for Hot-Surface Performance of High Temperature Thermal Insulation.

m. C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

n. C449 - Specification of Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

o. C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

p. C533 - Specification for Calcium Silicate Block and Pipe Thermal Insulation.

q. C534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

r. C547 - Specification for Mineral Fiber Preformed Pipe Insulation.

s. C552 - Specification for Cellular Glass Block and Pipe Thermal Insulation.

t. C553 - Specification for Mineral Fiber Blanket-Type Pipe Insulation (Industrial Type).

u. C592 - Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered).

v. C612 - Specification for Mineral Fiber Block and Board Thermal Insulation.

w. C916 - Standard Specification for Adhesives for Duct Thermal Insulation.

x. C921 - Practice for Determining Properties of Jacketing Materials for Thermal Insulation.

y. C1104 – Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.

z. C1071 - Standard Specification for Thermal and Acoustical Insulation.

aa. C1338 – Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

bb. E84 - Test Method for Surface Burning Characteristics of Building Materials.

cc. E119 - Test for Fire Resistance.

dd. G21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

ee. G22 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Bacteria.

2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Provide and install pipe and duct insulation in accordance with the following ASHRAE Standard:

a. 90 Energy Conservation in New Building Design.

3. National Fire Protection Association (NFPA): Manufacture insulation in accordance with the following NFPA standards:

a. 255 Test Methods, Surface Burning Characteristics of Building Materials.

B. Do not provide materials with flame proofing treatments subject to deterioration due to the effects of moisture or high humidity.

C. Products Containing Prohibited Chemicals:

1. Products containing the following prohibited chemicals for use as flame retardants or for other purposes will not be acceptable:

a. Pentabrominated diphenyl ether (CAS#32534-81-9)

b. Octabrominated diphenyl ether (CAS#32536-52-0)

c. Decabrominated diphenyl ether (CAS#1163-19-50

D. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing; or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

E. Corrosiveness: Provide insulation such that when tested in accordance with the following test, the steel plate in contact with the insulation shows no greater corrosion than sterile cotton in contact with a steel plate for comparison.

1. Test Specimen: Two specimens shall be used, each measuring 1" by 4" by approximately ½" thick.

2. Apparatus: Provide a humidity test chamber in which two polished-steel test plates, 1" wide, 4" long and 0.020" thick, shall be placed. Plates shall be clear finish, cold-rolled strip steel, American quality, quarter hard, temper No. 3, weighing 0.85 lb/sq. ft.

3. Procedure: The steel test plates shall be rinsed with cp benzol until their surfaces are free from oil and grease and allowed to dry. One piece of cold-rolled steel shall be placed between the two insulation specimens and secured with tape or twine. The test specimen and uncovered plate shall be suspended vertically in an atmosphere having a relative humidity of 95% (plus or minus 3%), and a temperature of 120°F (plus or minus 3°F), for 96 hours, and then be examined for corrosion.

F. Insulation thickness shall be the greater standard of that specified here or the State energy conservation requirements.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation. Also furnish necessary test data certified by an independent testing laboratory. Submit samples.

B. Provide a statement with the submittal indicating that no product submitted contains an amount equal to or greater than 0.10% by mass of the following chemicals:

1. Pentabrominated diphenyl ether (CAS#32534-81-9)

2. Octabrominated diphenyl ether (CAS#32536-52-0)

3. Decabrominated diphenyl ether (CAS#1163-19-50

C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product in maintenance manual.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coating to the site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

B. Store and protect insulation against dirt, water, chemical, and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Johns Manville, Owens-Corning, Knauf, Armstrong, Pittsburgh-Corning, Certainteed, Halstead, Rubatex, 3M FireMaster, Pabco, Reflectix, or approved equal. Manufacturer and insulation types listed below indicate a minimum acceptable level of quality required for each classification.

2.2 PIPE INSULATIONS

A. Glass Fiber: Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C 547 and meet ASTM C 585 for sizes required in the particular system. For all fluid distribution temperatures below 45°F the system shall be of a wicking type.

1. Manufacturers:

a. Johns Manville Micro-Lok plain with PVC cover Meeting ASTM C547; or Micro-Flex (pipe sizes larger than 18”), Knauf einsulation.

2. Applications: Insulation of piping up to 18” in diameter and 3” thick insulation.

3. 'K' Value: 0.23 at 75°F.

4. Maximum Service Temperature: 850°F.

5. Vapor Retarder Jacket: AP-T PLUS white kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP jacket with outward clinch expanding staples or vapor barrier mastic as needed.

B. Cellular Glass: Pittsburgh-Corning Foamglas Meeting ASTM C522: Cellular Glass Thermal Insulation:

1. 'K' Value: 0.35 at 75°F.

2. Density: 8.0 lbs./cu. ft.

3. Maximum Service Temperature: 900°F.

4. Provide with Pittsburg Corning Pittwrap jacketing.

C. Rigid polyisocyanurate foam: HiTHERM HT-300.

1. 'K' Value: 0.165 at 75°F (24°C)

2. Maximum Continuous Service Temperature: 300°F.

3. Vapor Retarder Jacket: Saran 540/SSL or Mylar laminate.

D. Hydrous Calcium Silicate: Johns Manville Thermo-12/Gold, ASTM C533; Rigid Molded Pipe:

1. 'K' Value: 0.40 at 300°F.

2. Maximum Service Temperature: 1,200°F.

3. Compressive Strength (block): Minimum of 200 psi to produce 5% compression at 1½" thickness.

4. Tie Wire: 16 gauge stainless steel with twisted ends on maximum 12" centers.

E. Flexible Elastomeric Closed Cell Thermal Insulation: Armacel, Rubatex k-flex ECO, closed-cell, halogen free, elastomeric insulation. Comply with ASTM-C177, ASTM E 84 and UL 181.

1. 'K' Value: 0.27 at 75°F.

2. Density: 3.0 to 6.0 lbs./cu.ft.

3. Maximum Service Temperature: 260°F.

4. Seal all seams and joints with contact adhesive.

F. Field Applied Jackets (For Interior Applications):

1. All longitudinal seams shall be located on bottom of pipes.

2. PVC Plastic: Johns Manville Zeston 2000. One piece molded type fitting covers and jacketing material, gloss white. Connect with tacks and pressure sensitive color matching vinyl tape.

3. Canvas Jacket: UL listed fabric, 6 oz/sq. yd. plain weave cotton, treated with dilute fire retardant lagging adhesive.

4. Aluminum Jacket: 0.016" thick sheet, embossed] finish, with longitudinal slip joints and 2" laps, die shaped fitting covers with factory attached protective liner.

5. Secure aluminum jackets with 3/8" or ½" stainless steel bands on 12" centers.

G. Field Applied Jackets (For Exterior Applications):

1. All longitudinal seams, on horizontal pipe runs, shall be installed on the bottom of pipes.

2. Aluminum Jacket: 0.016" (minimum) thick sheet, [smooth/embossed] finish, with longitudinal slip joints and 2" laps, die shaped fitting covers with factory attached protective liner.

3. Stainless Steel Jacket: Type 304 stainless steel, 0.010" minimum (smooth/corrugated) finish.

4. Secure stainless steel or aluminum jackets with ⅜" or ½" stainless steel bands on 12" centers.

5. Manufacturers: Pabco, Childers, RPR, or approved equal.

H. Removable Covers:

1. Provide removable covers on pumps, valves, air separators, vents, fittings, flanges, strainers, traps, etc., where periodic maintenance or removal of insulation may is required.

2. Use of premolded fittings with PVC covers is acceptable.

3. Use of lace-on type insulating blankets is acceptable.

2.3 EQUIPMENT INSULATIONS

A. Flexible Fiberglass Blanket: Johns Manville Microlite Type 75 Flexible Blanket:

1. 'K' Value: ASTM C518, 0.27 Btu•in./(hr•ft²•ºF) at 75°F installed full thickness.

2. Maximum Service Temperature: 250°F.

3. Density: 0.75 lb/cu ft.

4. Vapor Barrier Jacket: FSK (Foil-Scrim-Kraft) aluminum foil faced reinforced with fiberglass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and/or outward clinched expanded staples and vapor barrier mastic as needed.

B. Rigid Fiberglass Board: Johns Manville Mat-Faced Micro-Aire Rigid Board:

1. 'K' Value: ASTM C518, 0.23 Btu•in./(hr•ft²•ºF) at 75°F.

2. Maximum Service Temperature: 250°F.

3. Density: 3.0 lb/cu ft.

4. Vapor Barrier Jacket: FSK (Foil-Scrim-Kraft) aluminum foil faced reinforced with fiberglass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and/or outward clinched expanded staples and vapor barrier mastic as needed.

5. Facing: 1” galvanized hexagonal wire mesh stitched on one face of insulation. (Optional.)

C. Rigid Fiberglass Board: Johns Manville 1000 Spin-Glas Meeting ASTM C612; Rigid, Noncombustible:

1. 'K' Value: ASTM C518, 0.23 Btu•in./(hr•ft²•ºF) at 75°F.

2. Maximum Service Temperature: 850°F.

3. Density: 3.0 lb/cu ft.

4. Facing: 1” galvanized hexagonal wire mesh stitched on one face of insulation. (Optional.)

D. Cellular Glass: Pittsburgh-Corning Foamglas Meeting ASTM C552; Cellular Glass Thermal Insulation:

1. 'K' Value: 0.35 at 75°F.

2. Density: 8.0 lb/cu. ft.

3. Maximum Service Temperature: 900°F.

E. Hydrous Calcium Silicate: Johns Manville Thermo-12/Gold Meeting ASTM C533; Rigid Molded Block; Asbestos-Free Coded Throughout Material Thickness and Maintained Throughout Temperature Range:

1. 'K' Value: 0.40 at 300°F.

2. Maximum Service Temperature: 1,200°F.

3. Compressive Strength (block): Minimum of 200 psi to produce 5% compression, based on 1½" thickness.

4. Securement: Insulation shall be securely banded in place, tightly butted, joints staggered and secured with 16 gauge galvanized or stainless steel wire or ½" x .015" galvanized steel bands on 12” maximum centers for large areas.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that piping has been tested for leakage in accordance with specifications before applying insulation materials. All piping shall be inspected by Owner's Representative prior to installation of insulation. Any insulation applied prior to inspection shall be removed and new insulation applied at no additional cost to Owner. Notify Owner's Representative five (5) working days prior to insulation installation.

B. Verify that all surfaces are clean, dry and free of foreign material.

3.2 INSTALLATION

A. General:

1. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.

2. Remove and replace any insulation that has become wet or damaged during the construction process.

3. Continue insulation and vapor barrier at penetrations and supports, except where prohibited by code.

B. Piping Insulation:

1. Locate insulation and cover seams in least visible locations unless otherwise specified.

2. Neatly finish insulation at supports, protrusions, and interruptions.

3. Provide insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self sealing laps. Insulate complete system.

4. For insulated pipes conveying fluids above ambient temperature, secure jackets with self sealing lap or outward clinched, expanded staples. Seal ends of insulation at equipment, flanges, and unions.

5. Provide insert between support shield and piping on piping 1½" diameter or larger. Fabricate of Johns Manville Thermo-12, or other heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:

a. 1½" to 2½" pipe size 10" long

b. 3" to 6" pipe size 12" long

6. Use of metal saddles is acceptable as specified in Section 220500. Fill interior voids with segments of insulation matching adjoining pipe insulation.

7. Use of pipe hangers designed as an insulation coupling is acceptable in lieu of saddles and other devices. Klo-Shure coupling or equal.

8. For pipe exposed in mechanical equipment rooms or in finished spaces below 7 feet above finished floor, finish with Johns Manville Zeston 2000 PVC jacket and fitting covers, or aluminum or stainless steel jacket.

9. Insulation to be continuous through penetrations except cold water,

10. Provide a one inch air space between pipe insulation and sleeves/casings.

11. Where pumps, valves, strainers, etc., with insulation require periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage. Use of premolded covers or lace-on type insulation blankets is required.

12. For exterior applications:

    a. Provide weather protection jacket. Insulated pipe lengths, pumps, fittings, joints, and valves shall be covered with aluminum jacket or stainless steel jacket. Jacket seams shall be located on bottom side of horizontal piping. All lateral joints shall be caulked with a minimum 20-year silicone sealant (clear). All longitudinal joints, except those at the bottom of a horizontal pipe run, shall be caulked with a minimum 20-year silicone sealant (clear).

    b. Apply weather-resistant protective finish such as WB Armaflex to flexible elastomeric insulation. Insulation seams shall be located on the bottom side of horizontal piping. All lateral and longitudinal joints to be sealed with low V.O.C., UV inhibitive adhesive, such as Armaflex 520 BLV adhesive.

13. For underground installations, install per manufacturer's written instructions and recommendations.

14. When maintenance or service access for equipment will result in foot traffic over floor mounted insulated piping the contractor is to fabricate a permanent removable walkway to prevent damage to the piping and insulation.

C. Equipment Insulation:

1. See Piping Insulation above for additional requirements.

2. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands, per manufacturer’s recommendations.

3. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retardant cement.

4. Provide insulated dual temperature equipment or cold equipment containing fluids below ambient temperature with vapor retardant jackets.

5. For insulated equipment containing fluids above ambient temperature, provide jacket with or without vapor barrier.

6. Cover insulation with metal mesh and finish with heavy coat of insulating cement, mastic, or aluminum jacket as indicated in the drawings.

7. For equipment in mechanical equipment rooms or in finished spaces, finish with Johns Manville Zeston 2000 jacketing and fitting covers or aluminum or stainless steel jacketing.

8. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

9. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage. Use of lace-on type insulation blankets is acceptable.

3.3 PIPING INSULATION SCHEDULE

A. All insulation thicknesses shall meet or exceed state energy code requirements as noted below. Increase thickness ½" if exposed to exterior ambient air. Minimum thermal resistance in range of 4.2 to 4.6 per inch of thickness. Insulation thicknesses are based on fiberglass insulation and may be adjusted for equivalent insulation values for materials with superior "K" factors.

B. Fiberglass Insulation

	PIPE SIZE (inches)	THICKNESS (inches)
Domestic hot water	Up to 2 2 ½ and over	1 1 ½
Domestic hot water return	All Sizes	1
Domestic cold water	All Sizes	1
Roof and overflow drain bodies	All Sizes	1
Horizontal roof and overflow drainage	All	1
Piping exposed to freezing	All Sizes	1 ½
Plumbing vents within 10 feet of the exterior in freezing climates	All Sizes	1
Misc. drains from electric water coolers, ice machines, etc.	All Sizes	1

C. Elastomeric Foam (Closed Cell):

	PIPE SIZE (inches)	THICKNESS (inches)
Condensate drain pipes	All Sizes	1/2

D. Cellular Glass:

	PIPE SIZE (inches)	THICKNESS (inches)
Underground hot water and cold water piping	Up to 2 2 ½ and over	2 2

END OF SECTION

COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 COMMISSIONING AUTHORITY

A. The commissioning authority (CxA) has been contracted directly with the owner for this project. The CxA has overall responsibility for planning and coordinating the commissioning process. However, commissioning involves all parties involved with the design and construction process, including the Plumbing (Division 22) contractor, and all specialty subcontractors within Division 22, such as piping and water treatment, plus major equipment suppliers as required.

1.2 CONTRACTOR RESPONSIBILITY

A. The Plumbing (Division 22) contractor's responsibilities are defined in Section 01 9113, "Commissioning Requirements" of the specifications. These responsibilities apply to all specialty subcontractors and major equipment suppliers within Division 22. Each subcontractor and supplier shall review Section 01 9113, and their bids shall include for carrying out the work described, as it applies to each section within the Division 22 specifications, individually and collectively.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PLUMBING PIPING, VALVES AND SPECIALTIES

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 220500 - Basic Materials and Methods, and other Sections in Division 22 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to the following:

1. Pipe and Fittings
    a. Sanitary waste and vent
    b. Storm drain and overflow
    c. Cold water
    d. Hot water
2. Valves
    a. Water valves
    b. Backflow prevention valves
    c. Thermostatic mixing valves
    d. Solenoid valves
3. Thermometers and gauges
4. Piping specialties
    a. Pipe escutcheons
    b. Strainers
    c. Drip pans
    d. Air vent
    e. Dielectric unions
    f. Unions
    g. Flanges

h. Pipe sleeves

i. Sleeve seals

j. Valve boxes

k. Pipe coating

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 220500: Basic Materials and Methods

B. Section 220501: Plumbing

C. Section 224000: Plumbing Fixtures

D. Section 221123: Plumbing Equipment

E. Division 26: Electrical

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications:

1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.

2. Replacement parts shall be readily available and stocked in the USA.

B. Codes and Standards:

1. All work shall be in full accordance with all applicable codes, ordinances and code rulings.

2. The Contractor shall furnish without any extra charge the labor and material required for compliance of codes.

3. Perform all tests required by governing authorities and as required under all Division 22 Sections. Provide written reports on all tests.

4. Electrical devices and wiring shall confirm to the latest standards of NEC; all devices shall be UL listed and so identified.

5. All plumbing work shall comply with the Americans with Disabilities Act (ADA).

6. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for all piping, valves and specialties indicating dimensions, valve CV, tolerances etc.

B. Shop Drawings: Submit shop drawings indicating underground piping installation showing all fittings with inverts. Indicate all footings and grade beams.

C. Maintenance Data: Submit maintenance instructions on accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

1. All pipe, pipe fittings and valves shall be manufactured in North America. Alternatives may be acceptable, but must be submitted and approved by the Engineer prior to bidding.

B. Type M copper piping is not acceptable for any pressure water piping unless specifically noted otherwise.

C. For all Grade B piping specified below grade provide a mill report with production identification numbers for piping submitted to permit tracking of pipe by mill and production lot.

D. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be considered to be subsequent to all manufacturer's names used herein, unless specifically noted that substitutes are not allowed.

2.2 STANDARD PIPE AND FITTING

A. Domestic Hot and Cold Water Pipe & Fittings (Above Grade):

1. Pipe: ASTM B88, Type L, hard drawn copper water tube.

2. Fittings: ANSI B16.22, wrought copper, 95%-5% tin-antimony solder joints.

B. Domestic Water Pipe & Fittings (Below Grade):

1. Pipe: ASTM B88, Type K hard drawn copper water tube.

2. Fittings: Domestic Only, Elkhart, ANSI B16.22, wrought copper, 95%-5% tin-antimony solder joints. Wrap underground piping with Scotch Wrap or Pasco Wrap.

C. Sanitary Sewer, Vent, Rainwater Pipe & Fittings:

1. Pipe: Tyler or AB&I or Charlotte Pipe and Foundry, ASTM A-74, ASTM A-888 cast iron, bituminous coated, "No-Hub". Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and manufactured by AB &I, Charlotte or Tyler. Pipe showing rust or cracks in coating shall be removed and replaced.

2. Fittings: No-hub, ASTM A-888.

3. Couplings Below Grade: Heavy Duty Type 304 stainless steel couplings conforming to FM 1680 with neoprene sealing sleeve conforming to ASTM C-1540 having minimum shield thickness of 28 gauge. Husky SD-4000 or Clamp All 125 only.

4. Couplings Above Grade: Type 304 stainless steel couplings conforming to ASTM C-1540 and neoprene sealing sleeve, having minimum shield thickness of 34 gauge. Anaco or Ideal.

D. Trap Primer Piping:

1. Pipe: Domestic Only, ASTM B88, Type K, soft drawn copper water tube.

2. Fittings: No joints below ground. For pipes below grade double wrap with Scotch Wrap #51 or PASCO Wrap, with 50% overlap.

E. Condensate and indirect drains:

1. Pipe: ASTM B88, Type M, hard drawn copper water tube.

2. Fittings: ANSI B16.22, wrought copper.

3. Joints: Lead-free solder joints. Solder shall be lead-free nickel/silver bearing solder meeting ASTM B-32, ASTM B-828. Flux shall be water soluble and shall meet CDA standard test method 1.0 and ASTM B813-91.

4. Insulate condensate drain pipes with minimum ½" insulation to prevent moisture dripping from pipe.

2.3 VALVES: GENERAL

A. General: Valve ratings shall exceed respective system operating pressures by 50% (minimum). All valves shall be line size unless otherwise noted.

B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing manufacturer's figure number, size, location, and valve features for each required valve.

C. Shop Drawings: Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components.

D. Acceptable manufacturers (manufacturer and model number listed for individual valves indicates minimum acceptable by all manufacturers):

1. Gate, Ball, Check or Butterfly: Apollo, Hammond, Nibco (commercial grade, US manufacturer only), Milwaukee, Victaulic or Watts.

2. Lubricated Plug Valves: Homestead, Resun, or Rockwell.

3. Backflow Preventors: Apollo (basis of design), Ames, Febco, Watts or Wilkins.

4. Pressure Reducing Valves: Apollo, Watts, or Wilkins.

5. Solenoid Valves: ASCO, Automatic or Magnatrol.

6. Circuit Setters: Griswold (Venturi with characterized ball valve only), Wheatley (Y-globe type only), Armstrong, or Tour & Anderson.

E. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on the valve body.

F. Water piping to have threaded ball valves only.

G. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves, other than plug valves. Provide one wrench for every 10 plug valves, and one in each size. Provide extended levers/stems for valves on insulated lines. For manual valves 2 ½" and larger located 8 feet above the floor in mechanical rooms provide chain operator to permit operating the valve from 4'-0" above floor.

H. Valve Features:

1. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.

2. Drain: Comply with MSS SP-45, and provide threaded pipe plugs.

3. Flanged: Valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

4. Threaded: Valve ends complying with ANSI B2.1.

5. Solder-Joint not permitted

6. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

2.4 DOMESTIC PLUMBING SERVICE VALVES

A. Gate Valves:

1. 2" and Smaller: Class 150, MSS SP-80, ASTM B62 cast bronze body, threaded ends, bronze union bonnet, bronze wedge, rising stem, brass packing gland, non-asbestos packing and aluminum hand-wheel. All services except domestic water.

2. 2-1/2" and Larger: Class 150, MSS SP-70, ASTM A126 Grade B cast iron body, flanged ends, cast iron bonnet, cast iron wedge, bronze trim, rising stem, brass packing gland, repackable stuffing box, non-asbestos packing and cast iron hand-wheel. All services except domestic water.

B. Ball Valves:

1. All domestic water : 600 psi, 2 piece, bronze body, threaded ends for copper pipe stainless steel ball, reinforced teflon seat, adjustable packing, brass stem, steel handle, full port. Apollo 673## series, Nibco, Milwaukee.

C. Check Valves:

1. 2-1/2" and Smaller: Class 150, MSS SP-110, ASTM B62 and ASTM B16, cast bronze body, threaded ends for copper pipe, screwed cap, swing type, bronze disc.

2. 3" and Larger: Class 150, MSS SP-110, ASTM A126 class B cast iron body, bolted bonnet flanged ends, bolted cap, swing type, cast iron disc with bronze face rings. Apollo, Milwaukee, Nibco.

3. Vertical or High Flow: Class 150, cast bronze, high-flow body, TFE seat, brass check, stainless steel guide and spring

2.5 BACKFLOW PREVENTION VALVES

A. General: All backflow prevention valves shall be State approved and listed.

B. Reduced Pressure Zone Backflow Preventer for High Hazard Applications:

1. 2" and Smaller: Assembly shall consist of shutoff ball valves in inlet and outlet, and strainer on inlet. Assemblies shall include test cocks and pressure-differential relief valve located between two positive seating check valves and shall comply with requirements of ASSE Standard 1013 and AWWA C506. Bronze construction, threaded ends, stainless steel internal parts, and air gap fitting. Route pipe from air gap fitting to approved waste receptor. Febco or Conbraco.

2. 2-1/2" and Larger: Assembly shall consist of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies shall include test cocks and pressure-differential relief valve located between two positive seating check valves and shall comply with requirements of ASSE Standard 1015 and AWWA C506. Epoxy coated cast iron body

construction, flanged ends, stainless steel internal parts, bronze seats, and air gap fitting. Route pipe from air gap fitting to approved waste receptor. Febco or Conbraco.

C. Double Check Valve for Low Hazard Applications:

1. 2" and Smaller: Assembly shall consist of shutoff ball valves in inlet and outlet, and strainer on inlet. Assemblies shall include test cocks and two positive seating check valves and shall comply with requirements of ASSE Standard 1015 and AWWA C510. Bronze construction, threaded ends, and stainless steel internal parts. Febco or Apollo .

2. 2-1/2" and Larger: Assembly shall consist of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies shall include test cocks and two positive seating check valves and shall comply with requirements of ASSE Standard 1015 and AWWA C506. Epoxy coated cast iron body construction, flanged ends, and stainless steel internal parts. Febco or Conbraco

D. Atmospheric Vacuum Breaker: Assembly shall consist of a bronze vacuum breaker body with silicone disc, and full size orifice. Device shall be IAPMO listed, meet ASSE std. 1001, and ANSI std. A113.1.1 Chrome plated in finish areas.

E. Pressure Vacuum Breaker: Assembly shall consist of a one piece bronze or stainless steel body, with stainless steel spring loaded check, rubber diaphragm, and atmospheric vent, breakaway set screw. Provide chrome plated in finish areas.

2.6 PRESSURE RELIEF VALVES

A. Pressure Relief Valves: Constructed in accordance with ASME, 125-pound setting, and so stamped. Size as required. Watts #740 series or equal.

B. Temperature and Pressure Relief Valve: Constructed in accordance with ASME, 125-pound setting, and so stamped. Size as required.

2.7 THERMOSTATIC MIXING VALVES

A. General: Thermostatic valve constructed of brass and stainless steel, with screwdriver locking temp. regulator and adjustable check stops. Provide access door with cylinder lock. Finish as selected by Architect. Powers E480 or Leonard #210 SB.

B. Master: High-low master thermostatic assembly of size and capacity as indicated on drawings. Bi-metal motor, adjustable checkstops, inlet and outlet pressure gauges, thermometer with full port outlet ball valves shutoffs, locking temperature regulator and surface mount stainless steel cabinet as specified. Powers 1432-RC-E-Q or Leonard type TM186-PRV-RF-LTR-STSTL.

2.8 THERMOMETERS AND GAUGES

A. General:

1. Certification: Provide meters and gauges whose accuracies, under specified operating conditions, are certified by manufacturer.

2. No mercury shall be used in thermometers due to hazardous material classification.

3. Acceptable Manufacturers: Weksler, Winters, Trerice, Marshalltown or US Gauge.

B. Thermometers:

1. Bi-Metal Type: Provide bi-metal glass thermometers of materials, capacities, and ranges indicated, designed and constructed in service indicated. Accuracy shall be 1% +/- full scale with adjustable recalibration.

a. Case: Type 300 series stainless steel, hermetically sealed, glass window, 3" diameter dial, with adjustable angle.

b. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.

c. Scale: Satin faced, non-reflective aluminum, permanently etched markings.

d. Stem: Stainless steel, adjustable angle socket, length to suit installation.

2. Glass Thermometer: Provide adjustable angle 9” thermometer of materials, capacities and ranges as appropriate to medium being measured and designed and constructed for service indicated. Accuracy to be 1% +/- of full scale.

a. Case: Aluminum or Valox

b. Temperature Sensitive Gage Liquid: Organic non-toxic. No mercury permitted.

c. Scale: Aluminum painted white with black markings.

d. Connection: ½” NPT with thermowell, 1 ¼” UNF swivel nut without thermowell.

3. Range: Conform to the following:

a. Hot Water: 20°F - 240°F with 2°F scale divisions.

b. Cold Water: -40°F - 160°F with 2°F scale divisions.

C. Thermometer Test Wells:

1. Provide thermometer test wells as indicated, constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

D. Temperature Gauge Connector Plugs:

1. Provide temperature gauge connector plugs pressure rated for 500 psi and 200°F (93°C). Construct of brass and finish in nickel-plate, equip with ½" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting $^{1}/_{8}$" O.D. probe assembly

from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

E. Pressure Gauges:

1. General: Provide pressure gauges of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.

2. Type: General use, 1% accuracy ANSI B40.1 grade A, phosphor bronze bourbon type, bottom connection.

3. Case: Drawn steel or brass, glass lens, 4-1/2" diameter.

4. Connector: Brass with ¼" male NPT.

5. Scale: White coated aluminum, with permanently etched markings.

6. Pressure differential range shall be 100 psig minimum for the appropriate application with maximum 1 psig divisions.

F. Pressure Gauge Cocks:

1. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Gauge cock constructed of brass with ¼" female NPT on each end, and "T" handle brass plug.

2. Syphon: ¼" straight coil constructed of brass tubing with ¼" male NPT on each end.

3. Snubber: ¼" brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.

G. Pressure Gauge Connector Test Plugs:

1. Provide pressure gauge connector plugs pressure rated for 500 psi and 200°F (93°C). Constructed of brass and finish in nickel-plate, equip with ½" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion pressure gauge. Equip orifice with gasketed screw cap an chain. Provide extension, length equal to insulation thickness, for insulated piping.

2.9 PIPING SPECIALTIES

A. General:

1. Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or provide proper selection to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is installer's option.

B. Pipe Escutcheons:

1. Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime zinc base paint finish for unoccupied areas.

2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide stainless steel, cast brass or sheet brass escutcheons, solid or split hinged.

3. Pipe Escutcheons for Dry Areas: Provide stainless steel escutcheons, solid or split hinged.

4. Escutcheons shall not be used at acoustically significant penetrations so that resilient seals can be observed.

C. Low Pressure Y-Type Pipeline Strainers:

1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125% of the working pressure of piping system, with Type 304 stainless steel screens, with 3/64" perforations at 233 0.045" perforations per square inch.

2. Threaded ends, 2" and smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with hose bibb and brass cap. Sarco, Wheatley or Mueller.

D. Drip Pans:

1. Provide drip pans fabricated from 16-gauge galvanized sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top by structural angles. Provide hole, gasket, and flange at low point for watertight joint and 1" copper drain line connection. Extend 1” drain to nearest approved receptor.

E. Air Vent with Valves:

1. Install in all closed and open loop water systems at high points of systems and at any other point necessary to free system of air. A shut-off valve shall be provided in riser to each automatic vent valve to facilitate servicing. A 3/8" type "L" copper tubing drain line shall be run to drain receptor to carry away water that valve discharges. Manual type vent may be used in lieu of automatic type, where specifically shown on the Drawings. Hoffman #79 or Dole.

F. Dielectric Unions:

1. Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion. Provide brass dielectric unions on water system.

G. Dielectric Flanges:

1. Provide dielectric flanges for flanged transitions between dissimilar metal piping. Watts Series 3100 or approved equal.

H. Unions:

1. Unions shall be of type specified in following schedule:

a. Black Steel, 2" and smaller: 250 lb. screwed malleable iron, ground joint, brass to iron seat.

b. Black Steel, 2-1/2" and larger: 150 lb. cast iron screwed flanged, flat faced, full faced gasket.

c. Soldered Copper or Brass Pipe, 2" and smaller: 150 lb. cast bronze or copper, ground joint, non-ferrous seat with soldered ends.

d. Screwed Copper or Brass Pipe, 2" and smaller: 150 lb. cast brass, ground joint, brass to brass seat, with threaded ends.

e. Flanged Copper or Brass Pipe, 2-1/2" and larger: two (2) 150 lb. cast bronze flanges.

f. Manufacturer: EPCO, Mueller, Stanley G. Flagg or Watts.

I. Flanges:

1. Provide flanges at flanged connections to equipment, tanks and valves. Faces of flanges being connected shall be alike in all cases. Connection of raised-face flange to flat-faced flange not permitted.

2. Use ASTM A307, Grade B, bolts and nuts for cast iron flanges and ASTM A193 for steel flanges. Regular square head unfinished bolts with heavy semi-finished hex nuts ASTM A194. Cadmium plated where exposed to weather. Rating: 150 lb. or 300 lb. in high pressure portions.

3. Type of pipe and corresponding flanges as follows:

a. Screwed Black Steel Pipelines: 125 lb. black cast iron screwed flange, flat faces.

b. Welded Steel Pipe, 150 lb. black forges steel welding flanges, 1/16" raised fact ASTM A181 Grade I. Use flat face when connected to flat faced companion flange.

J. Pipe Sleeves:

1. Provide fire proof sleeve assemblies utilizing UL rated sealant systems at all fire rated penetrations. For non-rated sleeve penetrations pack the annular space between the pipe and sleeve with fiberglass and/or mastic.

2. Sleeves shall provide a minimum ½" annular clearance around pipe.

3. Sheet metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3" and smaller, 20 gauge; 4" to 6", 16 gauge; over 6", 14 gauge.

4. Steel pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

5. Iron pipe: Fabricate from cast iron or ductile-iron pipe; remove burrs.

6. Plastic and copper pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.

7. Sleeves through interior concrete walls and floors: Telescopic, submerged, adjustable sleeves by Adjust-to-Crete, AMI or Shamrock. Floor sleeves to extend a minimum of 1” above finished floor.

8. Through exterior walls and floor on grade: 150-pound class cast-iron pipe sleeve. Where waterproof membranes are used, provide membrane clamps. For insulated piping, sleeve diameter shall not be less than diameter of insulated pipe.

K. Sleeve Seals:

1. All sleeves shall be sealed to prevent intrusion of moisture, dust or insects.

2. Underground: For sleeves passing through exterior or foundation walls, provide mechanical link seal assembly.

3. Aboveground: For sleeves passing through walls or floors provide a non-toxic 3-hour rated fire resistant silicone foam sealant with a Flame Spread Rating of 20. Sealant to be tested and approved under UL 263, ASTM E119, and NFPA 251 Standards. All fire rated penetrations shall be sealed with approved UL System.

4. Local Approvals: All seals to be provided shall be in accordance with the regulations of all governing agencies of the city, county, and State Fire Marshal's Office.

L. Valve Boxes:

1. Concrete body, cast iron cover with vandal resistant screws, extensions as required to extend full depth to valve. Valve box cover lettering shall correspond to the valve service, "Water", "Gas", "Fire", "Sewer", etc. Christy #G8 or equal.

2.10 PIPE COATING

A. All underground steel and copper pipe fittings, and all above ground steel and copper pipe and fittings in corrosive air environments shall be covered with one of the following methods:

1. Twice Wrap 20 Mil. Scotch Wrap PVC No. 51, 50% overlap.

2. Prefabricated extruded plastic cover with joints sealed with two coats of 20 Mil. Scotch Wrap No. 51 or Pasco Wrap 20 mil weight.

2.11 EXPANSION COMPENSATORS

A. General: Pipe expansion, in general, is to be absorbed in bends, swing joints, expansion loops, and offsets. All piping mains, branches and runouts shall be installed to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Stresses shall be within allowable limits of ASME B31.1 for pressure piping. Vertical piping for domestic hot water, chilled water, heating water, steam and steam condensate shall be provided with expansion joints at each floor. Expansion products to conform to the standards of the Expansion Joint Manufacturer's Association. Expansion joints shall not required packing. Installer shall select materials and pressure/temperature ratings to suit intended service. Select packless expansion joints to provide 150% absorption capacity of calculated maximum piping expansion between anchors. All connections shall have ends to match piping system application.

B. Expansion Compensators (Pipe Compression and Extension): Multiple stainless steel bellows and stainless steel liner with shroud and end fittings. Keflex #311 series or approved equal.

C. Flexible Expansion Joint/Seismic Connector for Steel Pipe: Stainless steel hose and braid, 180° return, CSA approved, and end fittings. Metraflex #Metraloop or approved equal.

D. Flexible Connection for Steel Pipe (Piping and Equipment Located Outside the Building): Stainless steel hose and braid, with threaded or flanged ends. Metraflex #SST or approved equal.

E. Flexible Connection for Copper Pipe: Bronze hose and braid, copper tube ends. Metraflex #BBS or approved equal.

1. For non-critical pump connections. Furnish with fluorelastomer tube and cover to ASTM D2000 Grade 1HK710. The body shall be reinforced with rectangular body rings and six bias plies of fiberglass/kevlar fabric rated 190#/26" vacuum at 250°F. Provide galvanized flat (not L shaped) back up rings and control rods to limit maximum axial extension. Garlock #206 EZ-FLO or approved equal.

2. Flexible Ball Pipe Joints: Provide flexible ball pipe joints where indicated for piping systems, with materials and pressure/temperature ratings selected by installer to suit intended service. Design joints for 360° rotation, and with minimum of 50° angular flexing movement for sizes ¼" to 4". Provide two composition gaskets for each joint. Barco or approved equal.

F. Pipe Alignment Guides: Provide pipe alignment guides on both sides of expansion joints, and elsewhere as indicated on drawings. Guide shall be of carbon steel construction with split guiding cylinder and integral anchor base and internal four finger two-piece spider. Cylinder wall thickness shall be equal to schedule 40 wall thickness of pipe being guided. Spider shall be capable of clamping directly to pipe and moving only in an axial direction while inside cylinder. Anchoring directly to building substrate. Metraflex #Style IV or equal.

G. Expansion Loops: Provide field fabricated pipe expansion loops as detailed on the drawings or in place of mechanical expansion joints.

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal, or otherwise irregular work unless so indicated on Drawings or approved by Architect.

3.2 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

3.3 INSTALLATION

A. Coordinate the work between the various Plumbing Sections and with the work specified under other Divisions of the work or contracts toward rapid completion of the entire project. If any cooperative work must be altered due to lack of proper supervision or failure to make proper provisions in time, then the work hereunder shall include all expenses of such changes as are necessary in the work under other contracts, and such changes shall be directly supervised by and made to the satisfaction of the Engineer.

B. The cooperative work not included in the Plumbing Division related to the general construction work is as follows:

1. All formed concrete work.

2. Framed openings in masonry and other Architectural and Structural elements.

3. Wood grounds and nailing strips in masonry and concrete.

4. Sloping of floors to drains and floor sinks.

5. Sloping of roof-to-roof drains and overflow drains.

C. Inspect all material, equipment, and apparatus upon delivery and do not install any that may be subject to rejection as a result of damage or other defects. Provide tarps and visqueen cover to protect equipment and piping delivered to and stored at the site.

3.4 WORKING PRESSURES

A. All fittings, valves, pipe, specialties equipment shall be rated for the working pressure subjected in the installed locations.

B. Drawings indicate working pressure in each system. The rating of the equipment and material shall not be less than that of the system pressures.

3.5 PIPES SIZES TO EQUIPMENT

A. General: Pipe sizes indicated shall be carried full size to equipment served. Any change of size to match equipment connection shall be made within one foot of equipment.

B. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valve.

3.6 PIPING INSTALLATION

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints or couplings, but with adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance. Comply with ASME B31 Code for Pressure Piping.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.

C. Elevator Machine Rooms, Switchgear, Generator, Telecommunications, Telephone Rooms, and Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces. Route drip pan drain piping to floor drain, floor sink or other approved receptor.

3.7 WELDING

A. Qualifications of Welders: Welders performing work under this Contract shall be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators". Installation shall conform to ANSI 31.1 "Power Piping".

1. Submit for approval the names, identification, and welder's assigned number, letter or symbol of welders assigned to this project.

2. The assigned identification symbol shall be used to identify the work of each welder and shall be indelibly stamped immediately upon completion of each weld.

3. Welders shall be tested and certified for all positions.

4. Submit identifying stenciled test coupons made by each operator.

5. Any or all welders may be required to retake welding certification tests without additional expense.

6. When so requested, a welder shall not be permitted to work as a welder on this project until he has been recertified in accordance with NCWB.

7. Recertification of the welder shall be made after the welder has taken and passed the required tests.

8. Where piping 1-1/2 inches and smaller is butt or socket welded, submit 3 samples of test welds for approval.

3.8 PIPING SYSTEM JOINTS

A. All piping shall be cut squarely, free of rough edges and reamed to full bore. Piping shall be mechanically cleaned prior to make-up of joints and fully inserted into fittings.

B. Provide joints of type indicated in each piping system.

C. Thread pipe in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

D. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM. B-32, in accordance with IAPMO IS 3-93, ASTM B-828 and Copper Development Association recommended procedures. Joints shall be cleaned by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes shall be applied liberally to the outside of the pipe and the solder cup of the fitting. Fluxes shall be water soluble for copper and brass potable water

applications, and shall meet CDA standard test method 1.0 and ASTM B813-91. Solder shall be applied until a full fillet is present around the joint. Solder and flux shall not be applied in such excessive quantities as to run down interior of pipe. Lead solder or corrosive flux shall not be present at the jobsite.

1. Manufacturers:

   a. Solder: JW Harris "Bridgit" or Englehard "Silvabrite 100".

   b. Flux: Laco "Flux-Rite 90", MW Dunton "Nokorode CDA Flux", Hercules "Fluid Action Solder Flux".

E. Piping shall be capped during construction to prevent entry of foreign material.

F. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

3.9 VALVES

A. General: Except as otherwise indicated, comply with the following requirements:

1. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided as necessary.

2. Install valves, except butterfly valves, with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane without prior written approval. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

3. Install butterfly valves with stems mounted horizontally.

4. All valves mounted higher than 7' above floor in mechanical rooms and where indicated shall be installed with stem horizontal and equipped with chain wheels and chains extending to 6' above floor.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends of types of pipe/tube connections:

1. Copper Pipe, 2-1/2" and Smaller: Soldered-joint valves.

2. Steel Pipe, 2" and Smaller: Threaded joint valves.

3. Larger Pipe Sizes: One of the following, at installer's option:

   a. Flanged valves.

b. Lug valves.

D. Non-Metallic Disc: Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.

E. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

F. Fluid Control: Except as otherwise indicated, install gate, ball, plug, circuit setter, globe, and butterfly valves to comply with ASME B31.9.

G. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.

H. Wafer Check: Install between 2 flanges in horizontal or vertical position.

I. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

J. Valve Identification: Tag each valve in accordance with "Mechanical Identification" section.

K. Cleaning: Clean factory-finished surfaces. Repair marred or scratched surfaces with manufacturer's touch-up paint.

3.10 TEMPERATURE GAUGES

A. General: Install temperature gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor without supplemental illumination. All gages to be installed with snubbers to absorb system shock.

B. Install in the following locations, and elsewhere as indicated:

1. At outlet of hot water heaters.

2. At inlet and outlet of boilers.

3.11 MECHANICAL SLEEVE SEALS

A. Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form a watertight seal.

B. Fire Barrier Penetration Seals: Fill entire opening with sealing compound in compliance approved and listed UL system number. Adhere to manufacturer's installation instructions.

3.12 SUPPORTS AND HANGERS (SEE 220500)

3.13 EQUIPMENT RAILS AND PIPE PORTALS

A. Install per manufacturer's instructions.

B. Coordinate with other trades so units are installed when roofing is being installed.

C. Verify roof insulation thickness and adjust raise of cant to match.

3.14 VIBRATION CONTROL

A. Plumbing equipment and piping shall be vibration isolated in accordance with Section 220548 – Vibration Isolation of Plumbing Systems

3.15 EXPANSION LOOPS

A. Expansion Loops: Fabricate expansion loops as indicated, in locations indicated, and elsewhere as determined by installer for adequate expansion of installed piping system. Subject loop to cold spring which will absorb 50% of total expansion between hot and cold conditions. Provide pipe anchors and pipe alignment guides as indicated, and elsewhere as determined by installer to properly anchor piping in relationship to expansion loops.

B. Expansion Compensation for Risers and Terminals: Install connection between piping mains and risers with at least five pipe fittings including tee in main. Install connections between piping risers and terminal units with at least four pipe fittings including tee in riser.

3.16 EXPANSION COMPENSATORS

A. Install as noted on plans. Where plans do not indicate spacing of guides or other pertinent information, install per manufacturer's recommendations.

3.17 EXCAVATION AND BACKFILL

A. Underground piping shall be installed in stable, open trench work. Trench excavations shall be a minimum of 16” wide, true to line and grade. Contractor shall exercise all due shoring and safety procedures. No stones larger than 1” may be present in the trench to a minimum depth of 4” below the trench bottom. The trench shall be free of job site debris, and free of corrosive media. Pipe crown shall be not less than 24” below the finished ground surface for metallic pipe, and 30” for non-metallic pipe, unless otherwise indicated on the drawings or directed by the Architect. Trenches shall be kept free of excess moisture, and shall be kept open for only a short a time as necessary for installation, testing and inspection. Dispose of surplus excavation and seepage water as directed by the Architect.

B. Piping shall be properly bedded and backfilled over stable trench bottom to a level of at least 12” above the pipe crown with thin layers of unwashed sand, dampened but not puddle, and free of organic or corrosive materials and excessive moisture. Backfill shall be placed in thin layers not to exceed 6” and tamped by mechanical tampers to a minimum 90% Modified Proctor Density, in accordance with ASTM D-1557-58T. Trenches shall be backfilled to a minimum depth of 36”

prior to being wheel loaded. Replace to their original condition all turf, plants, concrete, asphalt, or other improvements which constitute landscaping, traffic areas or other improved areas which become disturbed by excavation. In graded and undeveloped areas, in addition to procedures specified above, backfill trenches with crown 8" above the surrounding surface.

C. Excavated and backfill in soils of unstable nature shall be provided as directed by Architect.

3.18 PIPE INSPECTIONS

A. It is the intent of the Contract Documents that systems be inspected at completion of each phase while under tests required for administrative authorities, and prior to concealment, i.e. "Rough-in" "top-out" and final.

B. Inspection – Below Grade: All piping installed below grade shall be inspected prior to burial by the Architect, the Owner's Representative or the Engineer. Contractor must notify Architect no less than 24 working hours prior to inspection time. Should the piping be buried prior to inspection the contractor may be requested to uncover the piping at no delay to the project and at no additional cost to the Owner.

C. Inspection – Above Grade: All piping installed above grade shall be made available for inspection upon completion and prior to finish of walls and ceilings. Notify the Architect, the Owner's Representative or the Engineer. Contractor must notify Architect no less than 24 working hours prior to the desired inspection time. Should the piping be hidden within the structure prior to inspection the contractor may be requested to uncover the piping at no delay to the project and at no additional cost to the Owner.

3.19 CLEANING, FLUSHING, DISINFECTING

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any).

B. Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports, and accessory items.

C. Inspect pressure piping in accordance with procedures of ASME B31.

D. Disinfect water mains and water service piping in accordance with Section 220501.

3.20 TESTING

A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Architect, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

B. Piping: Remove from the system, during testing, all equipment which would be damaged by test pressure. Replace removed equipment when testing has been accomplished. The system may be tested in sections as the work progresses; however, any previously tested portion shall become a part of any latter test of a composite system. Correct leaks by remaking joints with new material.

C. Test time will be accrued only while full test pressure is on the system, unless indicated otherwise. "Tolerance" shall be no pressure drop, except that due to temperature change in a 24-hour period. Inspect and test all work prior to burying or concealing. Test pressure shall be one and one-half times the system operating pressure or the listed test pressure below, whichever is greater:

System	Test Medium	Test Pressure	Tolerance-Test Period
Domestic Water	Water	150 psig	None – 8 hours
Soil and Waste	Water	10 ft head, 5 psi	No leaks – 8 hours
Vent	Water	Top of Vent Terminal	No leaks – 8 hours
Storm	Water	Top of Roof Drain	No leaks – 8 hours

D. Final Drainage, Waste and Vent Test: Upon project closeout, Contractor shall perform and certify that the DWV system has passed the following test:

1. After all plumbing fixtures have been installed and their traps filled with water, all vent terminals and building drains shall be closed and a U-tube water manometer shall be inserted into the trap of water closet and an air compressor testing apparatus shall be attached to any suitable opening. An air pressure of 1" water column as indicated on the manometer shall be introduced into the system. The pressure shall hold constant for a period of 15 minutes without the introduction of additional air. Leaks revealed during this test may be located by smoke test of other recognition methods.

E. Valves: Test all valve bonnets for tightness. Test operate all valves at least once from closed-to-open-to-closed position while valve is under test pressure. Test all automatic valves, including solenoid valves, and temperature and pressure relief valves, safety valves, and temperature and pressure relief valves not less than three (3) times.

F. Piping Specialties: Test all thermometers, pressure gauges, and water meters for accurate indication; automatic water feeders, air vents, trap primers, and vacuum breakers for proper performance. Test all air vent points to ensure that all air has been vented.

G. Backflow Preventers: Each testable backflow prevention device shall be tested and approved by certified testers after installation. Submit test results.

END OF SECTION

DOMESTIC HOT WATER HEATING EQUIPMENT

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 220500 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this section shall include but not necessarily be limited to the following:

1. Water heaters: Electric Tank Type
2. Expansion Tank
3. Recirculating Pump
4. Temperature and Pressure Relief Valves
5. Vacuum Relief Valves

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 220500: Basic Plumbing Materials and Methods

B. Section 224000: Plumbing Fixtures

1.4 QUALITY ASSURANCE – WATER HEATERS

A. Manufacturers and Representatives Qualifications. Firms regularly engaged in manufacture of water heating equipment, systems and service shall have been active in the field and whose products have been in satisfactory use in similar service for not less than 5 years.

B. Minimum Efficiency: Minimum efficiencies shall meet or exceed the values required by the local energy code. Water heater shall include automatic temperature control for maintaining leaving water temperature setpoint.

C. ASME Compliance: Condensing water heaters must be constructed in accordance with ASME Water heater and Pressure Vessel Code, Section IV (HLW) Potable Water Heaters.

1.5 SUBMITTALS

A. Prior to construction submit for approval all materials and equipment in accordance with Division 01. Submit manufacturer's data, colors, installation instructions, and maintenance and operating instructions for all components of this section including, but not limited to, the following:

1. Water heaters

2. Expansion Tank

3. Recirculating Pump

4. Thermostatic Mixing Valve

B. Electrical Work: Refer to Division 22, Section 220500 for requirements and coordinate with Division 26.

C. Product Data: Include performance data, operating characteristics, furnished specialties and accessories.

D. Water Heater Pressure Drop Curve: Submit pressure drop curve for flows ranging from 0 gpm to maximum value of water heater.

E. Shop Drawings: Submit rough-in drawings. Detail dimensions, rough-in requirements, required clearances, elevations, sections, and methods of assembly of components and anchorages.

F. Wiring Diagrams: Submit manufacturer's electrical requirements for electrical power supply wiring. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.

G. Operation and Maintenance Data: Submit maintenance data and parts lists for each type and size of water heater, control, and accessory, including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual, in accordance with requirements of Division 01. Submit operational manuals.

H. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.

I. Start-up: Provide written report on start-up in accordance with Section 220500.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products against dirt, water, chemical, and mechanical damage. Do not install damaged products - remove from project site.

1.7 COORDINATION

A. Coordinate size and location of concrete bases and attachments with structural design. Coordinate with Divisions 03 for specification of concrete, reinforcement and formwork requirements.

1.8 WARRANTY

A. Provide one year (12 months) warranty from date of Certificate of Occupancy. The warranty shall include repair or replacements of components that fail in materials or workmanship within the warranty period and shall include parts, labor, travel costs, and living expenses to repair or replace products or systems.

B. Tanks shall have a three-year (36 months) warranty against leaks. The warranty shall include replacement parts, labor, travel costs, and living expenses to repair or replace products or systems.

C. Condensing Water Heaters: The heat exchanger shall carry a minimum five years from shipment, non-prorated, limited warranty against any failure due to waterside corrosion, condensate corrosion, thermal stress, mechanical defects, or workmanship.

PART 2 - PRODUCTS

2.1 ELECTRIC TANK TYPE HOT WATER HEATER

A. Tank type electrical water heater with integral heating elements and insulated tank. Refer to drawings for locations, capacities, flow rates, power requirements and models.

B. All internal surfaces of the tank shall be glass-lined with an alkaline borosilicate composition that has been fused-to-steel. Tank shall be cathodically protected with adequate extruded magnesium anode. The entire vessel is to be enclosed in a round steel enclosure with baked enamel finish. Tank shall have a 150 psig working pressure. Foam insulated (R-16 minimum) tank to meet or exceed US DOE, ASHRAE/IESNA 90.1 and local energy code requirements.

C. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. Factory wired for non-simultaneous operation. Set initial water heater temperature to 140°F (minimum).

D. Heater shall include ASME pressure and temperature relief valve.

E. Manufacturers: A.O.Smith, Bradford-White, Lochinvar, Rheem or equal.

2.2 THERMAL EXPANSION TANK

A. Furnish and install one thermal expansion tank in each closed domestic hot water piping system as shown on drawings. Size tank per hot water piping system volume and operating conditions.

B. Construction:

1. Designed and constructed vessel per ASME Code Section VIII, Division 1.

2. Tanks rated for maximum 125 psig working pressure.

3. Steel tank with stainless steel connection and painted.

4. Butyl diaphragm bonded to polypropylene liner. Pre-charged air chamber to 55 psig with Schrader air valve.

5. Tank saddle support for wall or upper attachment support or ring base for floor attachment.

C. Manufacturer: Amtrol Therm-X-Trol, Watts PLT, Adamson, RECO or equal.

2.3 HOT WATER RECIRCULATING PUMPS

A. Furnish and install pumps with capacities as shown on plans.

1. Pumps shall be in-line type for installation in vertical or horizontal piping.

2. Pump must be capable of being serviced without disturbing piping connections.

B. Pump body shall be lead-free bronze or stainless steel construction and rated for 150 psi working pressure and 225^0F.

C. Impeller shall be lead-free bronze or stainless steel.

D. The pump shall have water-tight seals.

E. The motor shall be non-overloading at any point on the pump performance curve.

F. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.

G. Manufacturers: Bell and Gossett Series NBF or ecocirc, TACO, Grundfos or equal.

2.4 HOT WATER RECIRCULATING PUMP CONTROLLER

A. Electronic programmable controller with 7-day or 365-day programming feature to operate the recirculating pump during occupied periods. Controller shall have a minimum of four start/stop periods per day. Minimum mode switching intervals of 15 minutes.

B. The aquastat shall connect to the controller and override the ON time conditions whenever the temperature conditions are met to disengage the pump.

C. Thermostat (aquastat) switching modes: The pump shall engage (ON mode) whenever the return water temperature drops below 95^0F (adjustable) and shall disengage (OFF) whenever the return water temperature exceeds 105^0F (adjustable).

D. Temperature sensor shall be rated for temperature monitoring between -20^{0}F and +284^{0}F with response times less than 5 seconds and accuracy or +/- 1%. Adjustable well length and stainless steel body. Cable length and sensitivity as required for application.

E. Power supply: 115-120 VAC, 60 Hz, single phase.

F. Manufacturers: Honeywell, Kele, Mamac, Bell and Gossett or equal.

2.5 TEMPERATURE AND PRESSURE RELIEF VALVES

A. Temperature and Pressure Relief Valve: Lead free bronze body construction, thermostat and test lever, temperature relief set at 210^{0}F, and pressure relief set at 125 psi. Certified to meet ASME low pressure heating boiler code and ANSI Z21.22.

B. Manufacturers: Watts #LF Series (100XL, 40, 140, N240, 340), Cash Acme #FVX Series or equal.

2.6 VACUUM RELIEF VALVES

A. Vacuum Relief Valve: Provide on incoming cold water service where hot-water storage tank or indirect water heater is located at an elevation above the plumbing fixture outlets. Lead free brass body construction, protective cap, 1/2" male NPT, maximum operating temperature 250°F. Tested and rated to ANSI Z21.22.

B. Manufacturers: Watts #LFN36 Series, Cash Acme #VR-801, or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected. Refer to drawings and other specification sections for locations, dimensions and features required for each piece of equipment.

B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

C. Orient equipment so controls and devices needing service and maintenance have adequate access and code required clearances.

D. Connect piping with shutoff valves and unions as required for maintenance and system isolation.

E. Connect all drain outlets and route to approved termination locations as shown on the drawings and as required by code.

F. Start-Up: Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls. Start-up to be by authorized manufacturer's representative or agent.

G. Plumbing equipment and piping shall be vibration isolated in accordance with Section 220548 – Vibration Isolation of Plumbing Systems.

3.2 WATER HEATER EXAMINATION

A. Before water heater installation, examine roughing-in for equipment bases, anchor-bolt sizes and locations. Examine piping and electrical connections to verify actual locations, sizes and other conditions affecting water heater performance, maintenance and operations.

1. Final water heater locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where equipment heaters will be installed. Coordinate with Owner's Representative if there are concerns about proposed equipment locations. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 WATER HEATER INSTALLATION

A. Install water heaters and tanks level on bases or platforms as required and as shown on drawings. Coordinate with Division 03 for concrete materials and installation requirements.

B. Install water heaters in accordance with local, state, provincial, and national codes, laws, regulations, and ordinances.

C. Comply with manufacturer's installation instructions, including required service clearances and venting guidelines.

D. Provide seismic anchorage attachments on vertical tanks heaters with support points at upper 1/3 and lower 1/3.

E. Assemble and install water heater ASME listed Pressure/Temperature Relief Valve.

F. Install electrical devices furnished with water heater but not specified to be factory mounted.

G. Install control wiring to field-mounted electrical devices.

3.4 WATER HEATER CONNECTIONS

A. Piping installation requirements are specified in other Division 22 sections. Drawings indicate general arrangement of piping, fittings and specialties.

B. Install piping adjacent to water heater to permit service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection and pitched for gravity flow.

D. For condensing water heaters, provide condensate neutralizer in condensate drain pipe before termination at floor sink or other approved termination.

E. Connect cold and hot water piping to inlet and outlet connections with shutoff valves and dielectric union or flanges at each connection.

F. Multiple heaters shall be piped such that all cold water entering the system will go through the heat exchanger first. Each water heater shall have individual isolation valves for servicing and a hot water hose connection for start-up and field testing.

G. Install piping from safety pressure and temperature relief valves to nearest floor sink or to the exterior of the building.

H. Install vacuum relief valve in incoming cold water pipe to water heaters.

I. Provide one (1) glass thermometer and thermowell in the hot water pipe on the discharge side of the water heater or water heating system. Thermowell shall be brass or stainless steel. Install thermowell into tee fitting within 36" of water heater outlet. Thermowell may be installed horizontally or vertically, but thermometer must be mounted vertically and positioned for easy reading from a standing position. Adjust installation of thermometer and thermowell to extend no more than 2" into water flow path. Thermowell probe shall not restrict the water flow in the hot water pipe, therefore the tee fitting must be enlarged. Tee fitting diameter shall be oversized to equal, or exceed, the diameter of the supply water pipe plus the diameter of thermowell for the entire depth of thermowell probe.

J. Drain valve shall be readily accessible for installation of hose to facilitate maintenance draining. Elevate water heater and tanks, as necessary, to accommodate hose connection. See drawings for additional requirements.

K. Ground equipment according to Division 26 Section - Grounding and Bonding for Electrical Systems.

L. Connect wiring according to Division 26 Section - Low-Voltage Electrical Power Conductors and Cables.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

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.

B. Tests and Inspections

1. Installation and Startup Test: Perform installation and startup checks according to manufacturer's written instructions.

2. Leak Test: Repair leaks and retest until no leaks exist.

3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion, if necessary.

4. Controls and Safeties: Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

   a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.

   b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 2 months of date of Substantial Completion, provide on-site assistance adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.6 OPERATION MANUALS, START-UP SERVICE, WARRANTIES, ACCEPTANCE AND GUARANTEES

A. General: Refer to Section 220500 for requirements.

END OF SECTION

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 220500 - Basic Materials and Methods, and other Sections in Division 22 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this section shall include, but not necessarily be limited to, the installation of plumbing fixtures and trim.

1.3 RELATED WORK IN OTHER SECTIONS

A. Section 220500: Basic Materials and Methods

B. Section 220501: Plumbing

C. Section 221123: Plumbing Equipment

1.4 SUBMITTALS

A. Prior to construction submit for approval all materials and equipment in accordance with Division 01. Submit manufacturer's data, colors, installation instructions, and maintenance and operating instructions for all components of this section including, but not limited to, the following:

1. Plumbing fixtures.
2. Piping specialties.
3. Water Closets.
4. Urinals.
5. Lavatories.
6. Sinks.
7. Drinking fountains.

B. Shop Drawings: Submit rough-in drawings. Detail dimensions, rough-in requirements, required clearances, and methods of assembly of components and anchorages. Coordinate requirements with Architectural Woodwork shop drawings specified in Division 06 for fixtures installed in countertops and cabinets. Furnish templates for use in woodwork shop.

C. Samples: Submit samples of any piece of equipment requested by Architect for review and approval.

D. Wiring Diagrams: Submit manufacturer's electrical requirements and wiring diagrams for power supply to units. Clearly differentiate between portions of wiring that are factory installed and field installed portions.

1.5 CODES AND STANDARDS

A. Uniform Plumbing Code (UPC) with State Amendments.

B. State of Oregon Plumbing Specialty Code – SOPSC

C. All fixtures and faucets must meet all requirements of the State of Oregon Structural Specialty Code – SOSSC.

D. All fixtures and accessories must be approved for use by the State of Oregon.

E. All fixtures and faucets must meet all requirements of Americans with Disabilities Act (ADA).

F. State Energy Code

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products against dirt, water, chemical, and mechanical damage. Do not install damaged products. Remove damaged products from project site.

1.7 MAINTENANCE

A. Extra Stock:

1. Furnish special wrenches and other devices necessary for servicing plumbing fixtures, flush valves, and trim to Owner with receipt in a quantity of one device for each 10 fixtures.

2. Furnish faucet repair kits complete with all necessary washers, springs, pins, retainers, packings, o-rings, sleeves, and seats in a quantity of 1 kit for each 10 faucets.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide fixtures as specified.

B. Architect/Engineer shall review and approve any substitution requested by Contractor prior to bid submittal.

C. Provide fixture as specified, acceptable manufacturers:

1. Vitreous China or Cast Iron Fixtures: American Standard or Kohler.

2. Stainless Steel Sinks: Elkay or Just

   a. All stainless steel is 18 gauge, type 304 unless otherwise specified.

3. Drinking Fountains: Elkay, Halsey Taylor or Haws.

D. Provide faucet as specified. Acceptable manufacturers: Chicago Faucets, Moen or as indicated.

E. Provide a thermostatic mixing valve conforming to ASSE 1070 for all public lavatories and tub only fillers.

F. Provide flush valve as specified. Acceptable manufacturers: Sloan, or Moen.

G. Provide commercial grade toilet seat as specified. Acceptable manufacturers: Beneke, Bemis, Church or Olsonite.

H. Provide heavy-duty cast iron commercial grade carrier as specified. Provide compact carriers where space is limited. Acceptable manufacturers: Ancon, Jay R. Smith, Wade or Zurn. No plastic parts on foundry items.

1. Wall hung water closet: J.R. Smith figs: 0210L/RY-M12, 0210DY-M12, 0240L/RY-M12, 0240DY-M12, 0410R/LY-M12 and 0410DY-M12.

2. Wall hung urinal: J.R. Smith fig: 0634-M12 or Zurn Z-1221-58.

3. Wall hung lavatory: J.R. Smith fig: 0700(D) –M31 concealed arm carrier.

I. Provide heavy duty commercial grade 17-gauge P-Trap and supplies with stops as specified. Provide heavy duty commercial grade lavatory supplies. Provide supplies meeting AB1953 no lead requirements. Supplies shall be ½"x 3/8" x 12" ground joint flexible riser with loose key angle stop with chrome plates I.P.S. brass nipple. Sink supplies shall be ½" x 12" ground joint flexible riser with loose-key angle stop with chrome plated I.P.S. brass nipple. Provide bell type escutcheons for both P-trap and supplies. Acceptable manufacturers: Zurn, Brasscraft, Chicago, or McGuire.

1. P-trap - Lav: Slip type Zurn Z-8702 PC or McGuire.

2. P-trap - Sink: McGuire C8912-DF or ZurnZ-8702.

3. Supply for Lavatory: McGuire LFBV165 or Zurn Z8804-LRQ.

4. Offset supply for barrier free lavatory: McGuire 158 WC.

5. Supply for Sink: McGuire LFH2167LK or Zurn ZH8803-XL-LR.

6. Supply for Water Closet: McGuire H2169LK or Zurn ZH-8807-CR.

7. Escutcheons: McGuire WE00D Series, wrought brass, bell type.

8. Lavatory grid strainer: McGuire 155A or Zurn Z-8743.

9. Barrier-free lavatory offset grid strainer: McGuire 155WC or Zurn 8746.

10. Sink Strainer: Elkay LK-18B.

J. Insulation: provide white molded closed cell vinyl pre-fab insulation on P-Trap and on both hot and cold water supply for barrier free lavatories and sinks. Acceptable manufacturers: Plumberex, True-Bro, and Zurn. Bag type insulators are not acceptable.

2.2 FIXTURE LISTING

A. WC-1 Water Closet - HET:

1. Fixture: Kohler K-4325 Kingston, wall hung, white vitreous china, elongated bowl, high efficiency siphon jet toilet.

2. Seat: Bemis 1655-SSC solid white plastic elongated open front seat less cover, self-sustaining stainless steel check hinges.

3. Flush Valve: Sloan Royal 111-1.28 Manual Valve.

4. Mounting Height: 15” floor to rim.

B. WC-2 Water Closet –ADA-HET:

1. Fixture: Kohler K-4330 Kingston, wall hung, white vitreous china, elongated bowl, high efficiency siphon jet toilet.

2. Seat: Bemis 1655-SSC solid white plastic elongated open front seat less cover, self-sustaining stainless steel check hinges.

3. Flush Valve: Sloan Royal 111-1.28 Manual Valve.

4. Mounting Height: 18” floor to top of seat.

C. UR-1 Urinal – Ultra low flow, ADA:

1. Fixture: Kohler K-4904-ET “Bardon” white ultra water saving washdown urinal.

2. Flush Valve: Mounting Height: 17” floor to lip.

D. L-1 Lavatory - Barrier Free:

1. Fixture: Kohler K-2849 “Hudson” wall hung vitreous china lavatory.

2. Faucet: Moen CA8301 automatic faucet with grid strainer. Outlet set @ 0.50 G.P.M.

3. Mixing Valve: Leonard 270. Mount behind Access Panel.

4. Mounting Height: Refer to architectural elevations for details.

E. S-1 Sink:

1. Fixture: Elkay #DLR-3122-10 18 gauge stainless steel countertop single bowl sink.

2. Faucet: Chicago Faucet 1100-GN2AE35-317AB 1.5 GPM, spread fitting with blade handles, rigid gooseneck spout.

3. Supplies: ½" flexible supplies with stops and escutcheon plate. Provide 1/4" flexible supply with stop for coffee maker.

4. Mounting Height: Refer to architectural details.

F. MS-1 Mop Sink:

1. Fixture: Commercial Enameling 87, 28” x 28” crescent floor set receptor, cast brass drain, stainless steel strainer and tailpiece and 20 gauge steel rim guard, splash guard.

2. Faucet: Chicago Faucet 897-CRCF; wall mounted combination fitting with vacuum breaker, wall brace, threaded hose outlet and integral stops, rough chrome finish, flow control set to 2 gpm (Omni A-810-2.0VR).

3. Sealant: Caulk edges of basin with silicone sealant.

4. Provide ½ connection to chemical dispenser with RPZ.

G. DF-1 Dual Height Drinking Fountain:

1. Fixture: Elkay EZWS-EDFPBM117K dual height, stainless steel, non-chilled, non-filtered, with bottle filler.

2. Mounting height: 36” to top of bubbler.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.

C. Examine walls, floors and cabinets for suitable conditions where fixtures are to be installed.

D. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design, and the referenced standards.

E. Comply with the installation requirements of ADA with respect to plumbing fixtures for the physically handicapped.

F. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.

G. Install a stop valve in an accessible location in the water connection to each fixture.

H. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork.

I. Seal fixtures to walls and floors using silicone sealant as specified in Division 07. Match sealant color to fixture color.

J. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.

K. Inspect each installed unit for damage. Replace damaged fixtures.

L. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow stream.

M. Replace washers or cartridges of leaking or dripping faucets and stops.

N. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

O. During construction cover all installed fixtures, sinks, and water coolers with cardboard boxes and wrap with Visqueen.

P. Provide flush valve and faucet support behind wall.

END OF SECTION

BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 01 - General Requirements, and shall include all Mechanical Sections specified herein.

1.2 SCOPE OF THIS SECTION

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Compliance with all codes and standards applicable to this jurisdiction
2. Shop Drawings for Equipment
3. Coordination Documents
4. Record Drawings
5. Start-up Service and Building Commissioning
6. Instruction, Maintenance, and O & M Manuals
7. Work associated with Delivery, Storage, and Handling of products
8. Work associated with provision of Temporary Facilities
9. Preparation of Posted Operating Instructions
10. Meeting Project Safety and Indemnity requirements
11. Proper Cleaning and Closing
12. Supplying proper Warranty information
13. Supply specified Guarantee documentation
14. Design and provision of Supports and Anchors
15. Pipe Portals
16. Equipment Rails
17. Access Panels and Doors
18. Identification Markers
19. Coordination of Electrical requirements for equipment provided

1.3 DESCRIPTION OF WORK

A. The Contract Documents, including Specifications and Construction Drawings, are intended to provide all material and labor to install complete heating, ventilating, air conditioning systems for the building and shall interface with all existing building systems affected by new construction.

B. The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract Drawings and he shall coordinate his work with that of the other trades to avoid interference. The plans are diagrammatic and show generally the locations of the fixtures, equipment, and pipe lines and are not to be scaled; all dimensions and existing conditions shall be checked at the building.

C. The Contractor shall comply with the project closeout requirements as detailed in General Requirements of Division 01.

D. Where project involves interface with existing building and site systems, every effort has been made to note existing utilities and services. However, the Contractor should thoroughly familiarize themselves with existing conditions and be aware that in some cases information is not available as to concealed conditions, which exist in portions of the existing building affected by this work.

1.4 DESCRIPTION OF BID DOCUMENTS

A. Specifications:

1. Specifications, in general, describe quality and character of materials and equipment.

2. Specifications are of simplified form and include incomplete sentences.

B. Drawings:

1. Drawings in general are diagrammatic and indicate sizes, locations, connections to equipment and methods of installation.

2. Before proceeding with work check and verify all dimensions.

3. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.

4. Make adjustments that may be necessary or requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.

5. Where existing pipes, conduits and/or ducts prevent installation of new work as indicated, relocate, or arrange for relocation, of existing pipes, conduits and/or ducts. Verify exact location and elevation of existing piping prior to any construction.

6. If any part of Specifications or Drawings appears unclear or contradictory, apply to Architect or Engineer for his interpretation and decision as early as possible, including during bidding period.

1.5 DEFINITIONS

A. "Above Grade": Not buried in the ground and not embedded in concrete slab on ground.

B. "Accessible": Ability to perform recommended maintenance without removal of services or equipment and requiring no special platforms.

C. "Actuating" or "Control" Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

D. "Below Grade": Buried in the ground or embedded in concrete slab on ground.

E. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

F. "Connect": Complete hook-up of item with required service.

G. "Exposed": Not installed underground or "concealed."

H. "Furnish": To supply equipment and products as specified.

I. "Indicated," "Shown" or "Noted": As indicated, shown or noted on Drawings or Specifications.

J. "Install": To erect, mount and connect complete with related accessories.

K. "Motor Controllers": Manual or magnetic starters (with or without switches), individual push buttons or hand-off-automatic (HOA) switches controlling the operation of motors.

L. "Piping": Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

M. "Provide": To supply, install and connect as specified for a complete, safe and operationally ready system.

N. "Reviewed," "Satisfactory" or "Directed": As reviewed, satisfactory, or directed by or to Architect/Engineer/Owner.

O. "Rough-In": Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

P. "Shall": An exhortation or command to complete the specified task.

Q. "Similar" or "Equal": Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

R. "Supply": To purchase, procure, acquire and deliver complete with related accessories.

S. "Typical" or "Typ": Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

T. "Will": A desire to complete the specified task. Allows some flexibility in application as opposed to "Shall".

U. "Wiring": Raceway, fittings, wire, boxes and related items.

V. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

1.6 RELATED WORK SPECIFIED ELSEWHERE

A. All Division 23 Mechanical sections included herein.

B. Division 33: Utility Site Work. <<<<<Coordinate with Civil Engineer>>>>>

1. Coordination of excavation of trenches and the installation of mechanical systems and piping on site.

C. Division 03: Concrete.

1. All concrete work for Mechanical Division shall be included in Division 23 under the appropriate Sections and shall include:

a. Concrete curbs and housekeeping pads for the mechanical equipment.

b. Thrust blocks, pads, and boxes for mechanical equipment.

c. Coordination of floor drain and floor sink installations in sloped floors.

D. Division 07: Thermal and Moisture Protection.

1. Flashing and sheet metal

2. Sealants and caulking

3. Firestopping

E. Division 09: Painting:

1. Division 23 installers shall perform all painting, except where specifically stated otherwise in Division 09.

2. Painting of all exposed steel, piping, ductwork, insulation, equipment and materials

3. Paint all exposed gas piping, interior and exterior to the building, yellow.

F. Division 10: Miscellaneous Metals.

1. Exterior louvers and grilles shall be included in this Section.

G. Division 26: Electrical is related to work of:

1. Power connections to all mechanical equipment

H. Division 28: Electronic Safety and Security is related to work of:

1. Fire protection alarms and relays

2. Smoke detector and monitoring

3. Life Safety Systems

1.7 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Perform all tests required by governing authorities and required under all Division 23 Sections. Provide written reports on all tests.

C. Electrical devices and wiring shall conform to the latest standards of NEC; all devices shall be UL listed and labeled.

D. All mechanical work shall comply with the Americans with Disabilities Act (ADA).

E. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

F. Provide in accordance with rules and regulations of the following:

1. Building Codes enforced by the Authority Having Jurisdiction in Oregon:

a. 2014 Oregon Structural Specialty Code (OSSC) based on 2012 International Building Code (IBC)

b. 2014 Oregon Energy Efficiency Code (OEESC) based on the 2009 International Energy Conservation Code (IECC)

c. 2014 Oregon Mechanical Specialty Code (OMSC) based on 2012 International Mechanical Code (IMC) and 2012 International Fuel Gas Code (IFGC) with State Amendments

d. 2014 Oregon Plumbing Code (OPC) based on 2009 Uniform Plumbing Code (UPC) with State Amendments

e. 2014 Oregon Fire Code (Based on the 2012 International Fire Code)

f. 2014 Oregon Electric Specialty Code (Based on the 2014 National Electric Code (NEC) with State Amendments

2. Local, city, county and state codes and ordinances

3. Local Bureau of Buildings

4. Local Health Department

5. Local and State Fire Prevention Districts

6. State Administrative Codes

G. Provide in accordance with appropriate referenced standards of the following:

1. NFPA - National Fire Protection Association

2. AABC - Associated Air Balance Council

3. CSA - Canadian Standards Association

4. ADC - Air Diffuser Council

5. AMCA - Air Moving and Conditioning Association

6. ANSI - American National Standards Institute

7. ARI - Air Conditioning and Refrigeration Institute

8. ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers

9. ASME - American Society of Mechanical Engineers

10. ASTM - American Society for Testing Materials

11. AWS - American Welding Society

12. FM - Factory Mutual

13. MSS - Manufacturer's Standardization Society

14. NEMA - National Electrical Manufacturer's Association

15. SMACNA - Sheet Metal and Air Conditioning Contractors National Association

16. UL - Underwriter's Laboratories

17. ADA - Americans with Disabilities Act

18. ETL - Electrical Testing Laboratories

1.8 QUALITY ASSURANCE

A. Manufacturer's Nameplates: Nameplates on manufactured items shall be aluminum or Type 304 stainless steel sheet, not less than 20 USG (0.0375"), riveted or bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of equipment data.

B. Current Models. All work shall be as follows:

1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.

2. Replacement parts shall be readily available and stocked in the USA.

C. Experience: Unless more stringent requirements are specified in other sections of Division 23, manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than one year prior to the date of bidding for this project.

1.9 GENERAL REQUIREMENTS

A. Examine all existing conditions at building site.

B. Review contract documents and technical specifications for extent of new work to be provided.

C. Provide and pay for all permits, licenses, fees and inspections.

D. Prepare a Construction IAQ Management Plan meeting the SMACNA IAQ guidelines. See Section 233113 Air Distribution for a summary of requirements.

E. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for mechanical access.

F. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to Equipment Specifications in Divisions 02 through 48 for rough-in requirements.

G. Coordinate mechanical equipment and materials installation with other building components.

H. Verify all dimensions by field measurements.

I. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

J. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

K. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

L. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Contractor to provide for all cutting and patching required for installation of his work unless otherwise noted.

M. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

N. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations.

O. Coordinate the installation of mechanical materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, sprinkler piping and heads, and other installations.

P. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

Q. Coordinate with Owner in advance to schedule shutdown of existing systems to make new connections. Provide valves in new piping to allow existing system to be put back in service with minimum down time.

R. All materials (such as insulation, ductwork, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

S. Coordinate installation of floor drains and floor sinks with work of other trades, such that finished floor slopes to drains and floor sinks are flush with surrounding floor.

T. Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this Division. Any such products installed as part of the work of the Division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor.

1.10 MINOR DEVIATIONS

A. The Drawings are diagrammatic and show the general arrangements of all mechanical work and requirements to be performed. It is not intended to show or indicate all offsets, fittings, and accessories which will be required as a part of the work of this Section.

B. The Contractor shall review the structural and architectural conditions affecting his work. It is the specific intention of this section that the contractor's scope of work shall include:

1. Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications

2. Minor deviations from the mechanical plans required by architectural and structural coordination.

C. The Contractor shall study the operational requirements of each system, and shall arrange his work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the proper and efficient installation of all systems from the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the "Electrical Work". Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labor and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

D. Minor deviations in order to avoid conflict shall be permitted where the design intent is not altered.

E. Advise the Architect, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Architect of conflict.

1.11 PRODUCT SUBSTITUTIONS

A. The Contractor shall certify the following items are correct when using substituted products other than those scheduled or shown on the drawings as a basis of design:

1. The proposed substitution does not affect dimensions shown on drawings.

2. The Contractor shall pay for changes to building design, including engineering design, detailing, structural supports, and construction costs caused by proposed substitution.

3. The proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.

4. Maintenance and service parts available locally are readily obtainable for the proposed substitute.

B. The Contractor further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item.

C. The Contractor agrees that the terms and conditions for the substituted product that are found in the contract documents apply to this proposed substitution.

1.12 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with Division 01 requirements.

B. After approval of preliminary list of materials, the Contractor shall submit Shop Drawings and manufacturer's Certified Drawings to the Architect for approval.

C. The Contractor shall submit approved Shop Drawings and manufacturer's equipment cuts, of all equipment requiring connection by Division 26, to the Electrical Contractor for final coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate with Division 26.

D. Submittals and Shop Drawings shall be submitted as a complete package bound in a 3-ring binder with tabs for each specification section. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Submit six (6) typed copies of submittals. Refer to Division 01 for additional requirements.

1.13 UNIT PRICING SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with Division 01 requirements.

B. Preliminary List of Materials and Unit Price Items: Within thirty (30) days after awarding of the Contract, submit to architect for preliminary approval a complete list of manufacturer’s names and model numbers of proposed materials and equipment. Also include proposed list of unit price items for review.

1. Indicate substituted items.

2. Identify test and balancing agency.

3. Identify independent testing laboratory for water analysis.

C. The Contractor shall submit with preliminary list of materials a unit price list for each item furnished on this project. Included with price shall be labor cost index.

D. Submittals and Shop Drawings shall be submitted as a complete package bound in a 3-ring binder with tabs for each specification section. Submit six (6) typed copies of submittals. Refer to Division 01 for additional requirements.

1.14 COORDINATION DOCUMENTS

A. The Contractors shall prepare coordinated 3D Shop Drawings to coordinate the installation and location of all HVAC equipment, ductwork, grilles, diffusers, piping, fire sprinklers, lights, audio/video systems, electrical services and all system appurtenances. The Coordination Drawings

shall include all mechanical rooms and floor plans. The Drawings shall be Overlay Drawings showing each discipline on a single sheet. The Drawings shall be keyed to the structural column identification system, and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Architect and the structural requirements, and all other trades (including HVAC, Plumbing, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide reasonable maintenance access requirements. When conflicts are identified, modify system layout as necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor, Architect, and Owner. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

B. The Drawings shall be prepared as follows:

1. The Sheet Metal (Mechanical) Contractor shall prepare Drawings to an accurate scale of 1/4" = 1'-0" or larger. Drawings are to be same size as Contract Drawings and shall indicate location, size and elevation above finished floor, of all HVAC equipment, ductwork, and piping. Plans shall also indicate proposed ceiling grid and lighting layout, as shown on electrical plans and reflected ceiling plans.

2. The Plumbing Contractor shall indicate all plumbing lines including fittings, hangers, access panels, valves, and bottom of pipe elevations above finished floor.

3. The Fire Protection Contractor shall indicate location of all sprinkler heads and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.

4. Plans are to incorporate all addenda items and change orders.

5. Distribute plans to all trades and provide additional coordination as needed.

C. Advise the Architect in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Architect of conflict.

D. Provide means of access to all valves, dampers, controllers, operable devices, and other apparatus that may require adjustment or servicing.

E. Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Architect of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

F. Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

G. Provide copy of Record Drawings to Testing and Balancing Contractor for their use when doing their work.

1.15 RECORD DRAWINGS

A. Before commencing installation, obtain an extra set of prints from Architect, marked "Record". Keep this set of Drawings at the job site at all times, and use it for no other purpose but to mark on it all the changes and revisions to the Contract Drawings resulting from coordination with other trades. At the completion of the project:

1. Edit project Coordination Drawing files to incorporate all site markups, changes, and revisions to the Contract Drawings. Submit plots of Record Drawings and six copies CD Roms labeled with all record 3D Coordination drawing files.

B. Provide copy of Record Drawings to Testing and Balancing Contractor for use when doing his work.

C. Mark Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e. – valves, traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

D. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

E. Refer also to Special Conditions in Division 01 for full scope of requirements.

1.16 START-UP SERVICE AND BUILDING COMMISSIONING

A. Prior to start-up, be assured that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

B. Provide services of factory-trained technicians for start-up of air conditioning units, temperature controls, chillers, boilers, pumps, and other major pieces of equipment. Certify in writing compliance with this Paragraph, stating names of personnel involved and the date work was performed.

C. Provide certificates of calibration for all sensors required for control and monitoring including temperature and pressure.

D. Refer to other Division 23 Sections for additional requirements.

1.17 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. O&M Manuals: Upon completion of the work, and prior to training of Owner's personnel, the Contractor shall submit to the Architect complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and

maintenance for equipment furnished and installed as specified in this section, bound in a durable binder. Refer to Division 01.

B. Contractor shall be responsible for providing proper instruction of the of Owner's personnel for operation and maintenance of equipment, and apparatus installed as specified in Division 23 to be no less than two hours for each piece of equipment. The Contractor shall develop and submit training materials prior to this training. These materials shall include qualifications of the trainer, training agenda, learning objectives, and a written test to be administered at the end of the training session. Operation and Maintenance manuals must present, incorporated and referenced in the training sessions.

1.18 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping shall be stored in bundles covered with visqueen. Piping showing signs of rust shall be removed from site and replaced.

C. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.19 TEMPORARY FACILITIES

A. Refer to Division 01 for the requirements of temporary water and sewer for construction and safety. Provide temporary heating, air conditioning, ventilation, water, and sewer, etc. services as necessary during the construction period and as required to maintain operation of existing systems.

B. Temporary Heating for Commissioning Tests:

1. Provide temporary heating where needed to provide false load for commissioning tests.

2. Temporary heating may be from the permanent heating system of the project or from a dedicated temporary heating system. If temporary system is necessary, select facilities known to be safe and without deleterious effect upon what work in place or being installed.

C. Temporary Cooling for Commissioning Tests:

1. Provide temporary cooling where needed to provide false load for commissioning tests.

2. Temporary cooling may be from the permanent cooling system of the project or from a dedicated temporary cooling system. If temporary system is necessary, select facilities known to be safe and without deleterious effect upon the work in place or being installed.

1.20 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.21 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal hours of work.

B. No act, service, Drawing, review, or Construction Review by the Owner, Architect, the Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify and defend the Owner, the Architect, the Engineers and their consultants, and each of their officers, employees and agents from any and all liability claim, losses or damage arising, or alleged to arise from bodily injury, sickness, or death of a person or persons, and for all damages arising out of injury to or destruction of property arising directly or indirectly out of, or in connection with, the performance of the work under the Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the Construction Contract Documents; but not including the sole negligence of the Owner, the Architect, the Engineers, and their consultants or their officers, employees and agents.

1.22 CLEANING AND CLOSING

A. All work shall be inspected, tested, and approved before being concealed or placed in operation.

B. Upon completion of the work, all equipment installed as specified in this section, and all areas where work was performed, shall be cleaned to provide operating conditions satisfactory to the Architect.

1.23 WARRANTIES

A. All equipment shall be provided with a minimum one-year warranty to include parts and labor. Refer to individual Equipment Specifications for extended or longer-term warranty requirements.

B. Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

C. Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period.

1.24 GUARANTEE

A. The Contractor shall guarantee and service all workmanship and materials to be as represented by him and shall repair or replace, at no additional cost to the Owner, any part thereof which may become defective within the period of one (1) year after the Date of Final Acceptance, ordinary wear and tear excepted.

B. Contractor shall be responsible for and pay for any damages caused by or resulting from defects in his work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

B. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words “or approved equal” shall be considered to be subsequent to all manufacturers’ names used herein, unless specifically noted that substitutes are not allowed.

2.2 SUPPORTS AND ANCHORS

A. General: Comply with applicable codes pertaining to product materials and installation of supports and anchors, including, but not limited to, the following:

1. UL and FM Compliance: Provide products, which are UL listed and FM approved.

2. ASCE 7-05: “American Society of Civil Engineers.”

3. 2006 International Building Code (IBC)

4. MSS Standard Compliance: Manufacturer's Standardization Society (MSS).

5. SMACNA: “Seismic Restraint Manual: Guidelines for Mechanical Systems.”

6. NFPA: Pamphlet number 13 and 14 for fire protection systems.

7. Provide copper plated or plastic coated supports and attachment for copper piping systems. Field applied coatings or tape is unacceptable.

8. Manufacturer: B-Line, Anvil International, Michigan, Tolco, Kin-Line, Simpson, or Superstrut.

B. Horizontal Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated hangers and supports of one of the following MSS types listed.

1. Adjustable Steel Clevis Hangers: MSS Type 1.

2. Adjustable Steel Swivel Band Hangers: MSS Type 10.

3. U-Bolts: MSS Type 24.

4. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:

a. Plate: Unguided type.

b. Plate: Guided type.

c. Plate: Hold-down clamp type.

5. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast iron floor flange.

6. Pipe Saddle Supports with U-Bolt: MSS Type 37, including steel pipe base support and cast iron floor flange.

7. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast iron floor flange.

8. Single Pipe Roller with Malleable Sockets: MSS Type 41.

9. Adjustable Roller Hangers: MSS Type 43.

10. Pipe Roll Stands: MSS Type 44.

11. Pipe Guides: Provide factory-fabricated guides of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

C. Horizontal Cushioned Pipe Clamp: Where pipe hangers are called out to absorb vibration or shock install a piping clamp with thermoplastic elastomer insert. Cush-A-Clamp or equal.

D. Vertical Piping Clamps: Provide factory-fabricated two-bolt vertical piping riser clamps, MSS Type 8.

E. Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of one of the following MSS types listed.

1. Steel Turnbuckles: MSS Type 13.

2. Steel Clevises: MSS Type 14.

3. Swivel Turnbuckles: MSS Type 15.

4. Malleable Iron Eye Sockets: MSS Type 16.

5. Steel Weldless Eye Nuts: MSS Type 17.

F. Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments of one of the following types listed.

1. Concrete Inserts: MSS Type 18 or Blue Banger Hanger by Simpson

2. Steel Brackets: One of the following for indicated loading:

a. Light Duty: MSS Type 31.

b. Medium Duty: MSS Type 32.

c. Heavy Duty: MSS Type 33.

3. Horizontal Travelers: MSS Type 58.

4. Internally Threaded Expansion Shell Anchors: By Simpson or approved equal.

5. Concrete Screw Anchors: Titen HD by Simpson or approved equal.

G. Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

1. Pipe Covering Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

2. Insulation Protection Shields: MSS Type 40, 18" minimum, or of the length recommended by manufacturer to prevent crushing of insulation. High-density insulation insert lengths shall match or exceed shield length.

3. Thermal Hanger Shields: Constructed of 360° insert of waterproofed calcium silicate (60 psi flexural strength minimum) encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation. Shield length shall match or exceed length of calcium silicate insert. Alternately Polyisocyanurate Urethane with a minimum flexural strength of 60psi, fully encased in 360 PVC (1.524 mm thick)SNAPPITZ. Provide assembly of same thickness as adjoining insulation.

4. Thermal Hanger Couplings: Constructed of high strength plastic coupling to retain tubing and join insulation at clevis hangers and strut-mounted clamps. Klo-Shure Insulation Coupling or equal.

H. Miscellaneous Materials:

1. Metal Framing: Provide products complying with NEMA STD ML1.

2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A36.

3. Cement Grout: Portland Cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand by volume, with minimum amount of water required for placement and hydration.

4. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required. Weld steel in accordance with AWS standards.

5. Pipe Brackets: "HoldRite" copper plated brackets. Insulate brackets attached to metal studs with felt.

2.3 PIPE PORTALS

A. Where pipe portals are not provided by other sections of Specification, provide prefabricated insulated pipe portals as required for piping penetrating through the roof where shown on plans. Field built pipe portals are acceptable alternatives - provide detail of construction for review.

B. Standard pipe portals, unless otherwise noted, shall be constructed as follows:

1. Curb shall be constructed of heavy gauge galvanized steel with continuous welds on shell seams.

2. Insulation to be 1-½" thick, 3 lb density rigid fiberglass.

3. Curb to have a raised 3" (minimum), 45° cant.

4. Curb to have 1-1/2" x 1-1/2" wood nailer (minimum).

5. Curb height to be 8" (minimum) above roof deck.

6. Cant shall be raised to match roof insulation thickness.

7. Cover or flashing to be constructed of galvanized steel or other suitable material to provide sturdy weather tight closure. Provide collars and rubber nipples with draw bands of sizes required by piping. Size curb, cover and nipples per manufacturer's recommendations.

8. Manufacturer: Roof Products Systems or Pate.

2.4 EQUIPMENT/PIPING RAILS

A. Where equipment/pipe rails are not provided by other sections of Specification, provide prefabricated reinforced equipment rails as required for support of equipment and piping. Field built curbs are acceptable alternatives - provide detail of construction for review.

B. Standard equipment rail, unless otherwise noted, shall be constructed as follows:

1. Construct of heavy gauge galvanized steel with continuous welds on shell seams.

2. Provide internal reinforcing supports welded as required to meet application requirements.

3. Equipment rails to have raised 3" (minimum), 45° cant.

4. Equipment rails to have 1 1/2" x 1 1/2" wood nailer (minimum) and counterflashing.

5. Equipment rail height to be 6" (minimum) above roof deck.

6. Cant shall be raised to match roof insulation thickness.

C. Equipment rails to be constructed to meet equipment size and weight requirements. Provide tapered rails to match roof pitch where required.

D. Manufacturer: Pate, Vent Products, Thy Curb or Roof Products Systems.

2.5 ACCESS PANELS AND ACCESS DOORS

A. Provide all access doors and panels to serve equipment under this work, including those which must be installed, in finished architectural surfaces. Frame of 16-gauge steel, door of 20 gauge steel. 1" flange width, continuous piano hinge, key operated, prime coated. Refer to Architectural Specifications for the required product Specification for each surface. Contractor is to submit schedule of access panels for approval. Exact size, number and location of access panels are not shown on Plans. Access doors shall be of a size to permit removal of equipment for servicing. Access door shall have same rating as the wall or ceiling in which it is mounted. Provide access panel for each trap primer or concealed valve, for fire and combination fire/smoke dampers, and for volume dampers. Use no panel smaller than 12" x 12" for simple manual access, or smaller than 24" x 24" where personnel must pass through. Provide cylinder lock for access door serving mixing or critical valves in public areas.

B. Included under this work is the responsibility for verifying the exact location and type of each access panel or door required to serve equipment under this work and in the proper sequence to keep in tune with construction and with prior approval of the Architect. Access doors in fire rated partitions and ceilings shall carry all label ratings as required to maintain the rating of the rated assembly.

C. Acceptable Manufacturers: Milcor, Karp, Nystrom, or Elmdor/Stoneman.

D. Submit markup of architectural plans showing size and location of access panels required for equipment access for approval by Architect.

2.6 IDENTIFICATION MARKERS

A. Mechanical Identification Materials: Provide products of categories and types required for each application as referenced in other Division 23 Sections. Where more than single type is specified for application, selection is installer's option, but provide single selection for each product category. Stencils are not acceptable.

B. Plastic Pipe Markers:

1. Snap-On Type: Provide pre-printed, semi-rigid snap-on, color coded pipe markers, complying with ANSI A13.1.

2. Pressure Sensitive Type: Provide pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1. Secure both ends of markers with color coded adhesive vinyl tape.

3. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

4. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

C. Plastic Duct Markers:

1. Provide 4 1/2" x 6" laminated plastic, ANSI A13.1 color coded duct markers with white core lettering.

2. Nomenclature: Include the following:

a. Direction of air flow

3. Duct service (supply, return, exhaust, etc.).

a. Duct origin (from)

b. Duct destination (to)

c. Design cfm

4. Provide a minimum of every 20 feet on all ducts with a diameter or width greater than 12".

D. Underground-Type Plastic Line Markers: Provide 6" wide x 4 mils thick multi-ply tape, consisting of solid metallic foil core between 2 layers of plastic tape. Markers to be permanent, bright colored, continuous printed, intended for direct burial service.

E. Valve Tags:

1. Brass Valve Tags: Provide 1 1/2" diameter 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener. Fill tag engraving with black enamel.

2. Plastic Laminate Valve Tags: Provide 3/32" thick engraved plastic laminate valve tags, with piping system abbreviations in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32" hole for fasteners.

3. Valve Tag Fasteners: Provide solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

4. Access Panel Markers: Provide 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

5. Non-potable Water Tags: 1/16" thick, engraved, plastic tags as indicated on Drawings.

F. Plastic Equipment Signs:

1. Provide 4-1/2" x 6" plastic laminate sign, ANSI A.13 color coded with engraved white core lettering.

2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

3. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

a. Name and plan number.

b. Equipment service.

c. Design capacity.

d. Other design parameters, such as pressure drop, entering and leaving conditions, rpm, etc.

G. Acceptable Manufacturers: Craftmark, Seton, Brady, Marking Services, Inc., or Brimar.

2.7 ELECTRICAL

A. General:

1. All electrical material, equipment, and apparatus specified herein shall conform to the requirements of Division 26.

2. Provide all motors for equipment specified herein. Provide motor starters, controllers, and other electrical apparatus and wiring which are required for the operation of the equipment specified herein.

3. Set and align all motors and drives in equipment specified herein.

4. Provide expanded metal or solid sheet metal guards on all V-belt drives to totally enclose the drive on all sides. Provide holes for tachometer readings. Support guards separately from rotating equipment.

5. Provide for all rotating shafts, couplings, etc., a solid sheet metal, inverted "U" cover over the entire length of the exposed shaft and support separately from rotating equipment. Cover shall extend to below the bottom of the shaft and coupling, and shall meet the requirements of the State Industrial Safety Regulations.

6. Specific electrical requirements (i.e., horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.

B. Quality Assurance:

1. Electrical components and materials shall be UL or ETL listed/labeled as suitable for location and use - no exceptions.

C. Motors:

1. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment Specifications.

2. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.

3. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range. Unless otherwise noted on plans, all motors ½ HP or larger shall be rated for 208 or 460 volt, 3-phase, operation. Unless otherwise noted on plans, all motors less than 1/2 HP shall be rated for 120 volt, single phase operation.

4. Temperature Rating: Motor meets class B rise with class F insulation.

5. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.

6. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

a. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.

b. VFD driven motors to be provided rated for inverter duty (NEMA Standard MG-1, Part 31) and equipped with a shaft grounding device or as an insulated bearing motor.

c. Bearings:

1) Ball or roller bearings with inner and outer shaft seals.

2) Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.

3) Designed to resist thrust loading where belt drives or other drives product lateral or axial thrust in motor.

4) For fractional horsepower, light duty motors, sleeve type bearings are permitted.

5) Enclosure Type:

a) Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.

b) Guarded drip-proof motors where exposed to contact by employees or building occupants.

c) Weather protected Type I for outdoor use, Type II where not housed.

d. Overload Protection: Built-in thermal overload protection where external overload protection is not provided and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.

e. Noise Rating: "Quiet."

f. Motors shall have a minimum efficiency per governing State or Federal codes, whichever is higher.

1) Motors shall meet the NEMA premium efficiency standard

g. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

D. Starters and Electrical Devices:

1. Motor Starter Characteristics:

a. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs.

b. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

2. Manual switches shall have pilot lights and all required switch positions for multi-speed motors. Overload Protection: Melting alloy or bi-metallic type thermal overload relays, sized according to actual operating current (field measured).

3. Magnetic Starters:

   a. Heavy duty, oil resistant, hand-off-auto (HOA), or as indicated, and pilot lights, properly arranged for single speed or multi-speed operation as indicated.

   b. Trip-free thermal overload relays, each phase, sized according to actual operating current (field measured).

   c. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.

   d. Built-in primary and secondary fused control circuit transformer, supplied from load side of equipment disconnect.

   e. Externally operated manual reset.

   f. Under-voltage release or protection for all motors over 20 hp.

4. Motor Connections: Liquid tight, flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Low Voltage Control Wiring:

1. General: 14 gauge, Type THHN, color coded, installed in conduit.

2. Manufacturer: General Cable Corp., Alcan Cable, American Insulated Wire Corp., Senator Wire and Cable Co., or Southwire Co.

F. Disconnect Switches:

1. Fusible Switches: For equipment 1/2 HP or larger, provide fused, each phase; heavy duty; horsepower rated; spring loaded quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the “OPEN” position; arc quenchers; capacity and characteristics as indicated.

2. Non-Fusible Switches: For equipment less than 1/2 horsepower, switch shall be horsepower rated; toggle switch type with thermal overload quantity of poles and voltage rating as required.

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal, or otherwise irregular work unless so indicated on Drawings or approved by Architect.

3.2 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

1. If the contractor must deviate from the manufacturer’s recommendations provide a letter from the manufacturer indicating the clearance to be provided is acceptable for scheduled performance and maintenance.

3.3 INSTALLATION

A. Coordinate the work between the various Mechanical Sections and with the work specified under other Divisions. If any cooperative work must be altered due to lack of proper supervision or failure to make proper and timely provisions, the alternations shall be made to the satisfaction of the Engineer and at the Contractor’s cost. Coordinate wall and ceiling work with the General Contractor, and his subcontractors in locating ceiling air outlets, wall registers, etc.

B. Inspect all material, equipment, and apparatus upon delivery and do not install any damaged or defected materials.

C. Penetrations through acoustically significant construction shall be sealed airtight in accordance with Resiliently Sealed Penetration Details and Section 079219 – Acoustical Joint Sealants. Escutcheons and/or sheetmetal angles shall not be used at acoustically significant penetrations so that resilient seals can be observed.

3.4 SUPPORTS AND HANGERS

A. HVAC equipment, ductwork and piping shall be vibration isolated in accordane with section 230548 – Vibration Isolation of HVAC systems.

B. Prior to installation of hangers, supports, anchors, and associated work, installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives, (if any), installers of other work with requirements specified.

C. Installation of Building Attachments: Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before

concrete is placed. Fasten insert securely to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through opening at top of inserts.

D. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors, and other building structural attachments.

E. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

F. Install hangers within 12 inches of every change in piping direction, end of pipe run or concentrated load, and within 36 inches of every major piece of equipment. Hangers shall be installed on both sides of flexible connections. Where flexible connection connects directly to a piece of equipment only one hanger is required.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

H. Support sprinkler piping and gas independently of other piping.

I. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

J. Hanger Spacing in accordance with following minimum schedules (other spacings and rod sizes may be used in accordance with the SMACNA Seismic Restraint Manual using a safety factor of five):

1. Copper Pipe:

Pipe Size	Max. Hanger Spacing	Rod Size
1/2" to 2"	6 feet	3/8"
2 ½" and larger	8 feet	1/2"

2. Caulked Bell and Spigot and Glass Pipe: Provide hanger for each section of pipe, located at shoulder of bell. Where an excessive number of fittings are installed between hangers, provide additional reinforcing.

K. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connecting equipment.

3. Insulated Piping: Comply with the following installation requirements:

   a. Clamps: Attach clamps, including spacers, (if any), to piping with clamps projecting through insulation.

   b. Shields: Where low compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install shields or inserts.

   c. Saddles: Where insulation without vapor barrier is indicated install protection saddles.

L. Installation of Anchors:

1. Install anchors at proper locations to prevent excessive stresses and to prevent transfer of loading and stresses to connected equipment.

2. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure.

3. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

4. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends.

M. Equipment Supports:

1. Provide all concrete bases, unless otherwise furnished as work of Division 03. Furnish to Division 03 Contractor scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories necessary for base construction.

2. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks.

N. Seismic restraints installed at vibration isolated equipment, ductwork and/or piping shall not support gravity loads.

O. Adjusting:

1. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

2. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

3. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 ROOF CURBS, EQUIPMENT RAILS, PIPE PORTALS

A. Install per manufacturer's instructions.

B. Coordinate with other trades so units are installed when roofing is being installed.

C. Verify roof insulation thickness and adjust raise of cant to match.

3.6 ELECTRICAL REQUIREMENTS

A. Mechanical Contractor shall coordinate with Division 26 work to provide complete systems as required to operate all mechanical devices installed under this Division of work.

B. Installation of Electrical Connections: Furnish, install, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, etc., motors and controls in accordance with the following schedule and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA's "Standard of Installation" to ensure that products fulfill requirements. Carefully coordinate with work performed under the Mechanical Division of these Specifications.

C. Division 23 has responsibilities for electrically powered or controlled mechanical equipment which is specified in Division 23 Specifications or scheduled on Division 23 Drawings. The specific division of responsibilities between Division 23 and 26 for furnishing or wiring this equipment is as follows:

1. Division 23 Mechanical Responsibilities:

a. MOTORS: Furnish and install all motors necessary for mechanical equipment.

b. MAGNETIC STARTERS: Furnish all magnetic starters whether manually or automatically controlled which are necessary for mechanical equipment. Furnish these starters with all control relays or transformers necessary to interface with mechanical controls. If the starter is factory installed on a piece of Division 23 equipment, also furnish and install the power wiring between starter and motor.

c. VARIABLE FREQUENCY DRIVES: All Variable Frequency Drives (where not provided by div 23 equipment manufacturer – see mechanical schedules) shall be provided by Division 26. Division 23 shall coordinate with Division 26 regarding actual motor horsepower of driven equipment based on approved submittals.

d. DISCONNECTS: Provide the disconnects which are part of factory wired Division 23 equipment. Factory wiring to include wiring between motor and disconnect or combination starter/disconnect.

e. CONTROLS: Division 23 Contractor (including the temperature controls subcontractor) is responsible for the following equipment in its entirety. This equipment includes but is not limited to the following:

1) Control relays necessary for controlling Division 23 equipment.

2) Control transformers necessary for providing power to controls for Division 23 equipment.

3) Line voltage thermostats.

4) Low or non-load voltage control components.

5) Remote bulb thermostats.

6) Non-life safety related valve or damper actuators.

7) Float switches.

8) Solenoid valves, EP and PE switches.

9) Refrigeration controls. (Division 26 provides power to refrigeration panels.)

f. FIRE AND LIFE SAFETY EQUIPMENT:

1) Fire/Smoke Dampers: Division 23 is responsible for providing and physically installing the damper and for installing any required control interface wiring to Division 23 controls.

a) Where fire/smoke dampers are part of an integrated smoke control system, Division 23 is responsible for providing dampers with necessary end switches for proof of closure. (See Section 233113.)

b) Where these dampers are not part of an integrated area wide smoke detection system, Division 23 is responsible for providing each fire/smoke damper with a dedicated duct detector installed per the requirements of the building code. (See Section 233113). If not integral with the damper assembly, the detector is to be installed by Div. 23 but wired for damper control by Div. 26.

2) Fire Sprinkler System: Division 23 is responsible for providing necessary controls including flow switches and alarm bells.

3) Specialized fire suppression systems: Division 23 is responsible for providing necessary system controls and any required control interface wiring to these controls. Division 26 is responsible for bringing power to point of connection with the system.

D. Division 26 has responsibilities for electrically powered or controlled mechanical equipment, which is specified in Division 23 Specifications or scheduled on Division 23 Drawings. The specific division of responsibilities between Division 23 and 26 for furnishing or wiring this equipment is as follows:

1. Division 26 Electrical Responsibilities:

a. MOTORS: Provide the power wiring for the motors.

b. MAGNETIC STARTERS: Except where magnetic starters are factory installed on Division 23 factory assembled equipment, Division 26 is to install magnetic starters furnished by Division 23 and install the necessary power wiring to the starter and from the starter to the motor. In the case of factory installed starters, Division 26 is to install the necessary power wiring to the starter.

c. VARIABLE FREQUENCY DRIVES: Provide all VFD's required to operate Division 22 and 23 equipment. Physically mount all VFD's, which are not specified to be installed on Division 23 factory assembled equipment. Provide the necessary power wiring to the VFD and from the VFD to the motor except in the case of factory installed VFD's. Where disconnects are installed between a VFD and a motor provide the interlocking wiring between the disconnect and VFD to insure that the drive is shutdown simultaneously with motor.

d. DISCONNECTS: Provide all disconnects necessary for Division 23 mechanical equipment which are not provided as part of factory wired Division 23 equipment. Provide power wiring to all disconnects. In addition provide power wiring between motor and disconnect when the disconnect is not factory installed. See also Variable Frequency Drive above for special wiring requirements.

e. CONTROLS: Division 26 Contractor is responsible for providing power to control panels and control circuit outlets.

f. FIRE AND LIFE SAFETY EQUIPMENT:

1) Fire/Smoke Dampers: Division 26 is responsible for power wiring to the damper and as follows:

a) Where these dampers are part of an integrated smoke control system Division 26 is responsible for providing the detectors and for all fire detection system wiring necessary to integrate dampers and related end switches into the system.

b) Where these dampers are not part of an integrated area wide smoke detection system, Division 23 is responsible for providing each fire/smoke damper with a dedicated duct detector installed per the requirements of the building code. (See Section 233113). If not integral with the damper assembly, the detector is to be installed by Div. 23 but wired for damper control by Div. 26.

2) Fire Sprinkler System: Division 26 is responsible for providing power wiring to fire protection controls including flow switches and alarm bells.

3) Specialized fire suppression systems: Division 26 is responsible for providing power wiring to suppression system and its controls.

2. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

3. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

4. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Architect/Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.

5. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

6. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

E. Motors and Motor Control Equipment: Conform to the standards of the NEMA. Equip motors with magnetic or manual line starters with overload protection. Motor starters and line voltage controls shall be installed under Electrical Section but located and coordinated as required under this Section of the work. Starters shall be combination type with non-fusible disconnect switches. All single phase fractional horsepower motors shall have built-in overload protection.

3.7 PAINTING

A. All painting shall be provided under this Division work, unless otherwise specified under Section 099100: Painting. Painting schemes shall comply with ANSI A13.1. Paint all exposed materials such as piping, ductwork, equipment, insulation, steel, etc. Exposed gas piping inside and outside the building shall be painted with two coats of "Rust-O-Leum" Yellow. The inside surface of visible ductwork above diffusers/grilles shall be painted flat black. Exposed copper indirect waste piping serving food service equipment shall be painted metallic chrome.

B. All exposed work under Division 23 shall receive either a factory finish or a field prime coat finish, except:

1. Exposed copper piping.

2. Aluminum jacketed outdoor insulated piping.

3.8 IDENTIFICATION MARKERS

A. General: Where identification is to be applied to surfaces which require insulation, painting, or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Piping System Identification:

1. Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.

2. Locate pipe markers as follows:

a. Near each valve and control device.

b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

d. At access doors, manholes, and similar access points which permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

f. Spaced horizontally at maximum spacing of 20' along each piping run, with minimum of one in each room. Vertically spaced at each story transversed.

C. Ductwork Identification: A minimum of every 20' for all ductwork 12" or more in diameter or width.

D. Mechanical Equipment Identification: Locate engraved plastic laminate signs on or near each major item of mechanical equipment and each operational device. Contractor shall be responsible for ensuring that the Contractor coordinates actual equipment tagging and nomenclature has been reviewed and approved by the Owner prior to fabrication. Provide signs for the following:

1. Main control and operating valves, including safety devices.

2. Meters, gauges, thermometers, dryers and similar units.

3. Compressors, and similar motor-driven units.

4. Fans, blowers, primary balancing dampers, ventilation zone dampers and mixing boxes.

5. RTUs units, fan coil units and similar equipment.

6. Strainers, filters, treatment systems and similar equipment.

7. Sprinkler and standpipe equipment.

E. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations. Equipment signs shall include an identification of the area or other equipment served by the equipment being labeled.

3.9 VIBRATION AND DYNAMIC BALANCING

A. Vibration tolerances shall be as specified by the "International Research and Development Corporation", Worthington, Ohio, measured by the displacement, peak to peak, as follows:

1. All Fans: Below severity chart labeled "FAIR", maximum velocity of 0.0785 in/sec, peak.

2. Pump and Electric Motors: Below severity chart labeled "SLIGHTLY ROUGH", maximum vibration velocity of 0.157 in/sec, peak.

3. Compressors: Same as pumps.

B. Correction shall be made to all equipment, which exceeds vibration tolerances specified above. Final vibration levels shall be reported as described above.

3.10 TESTING

A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Architect, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

B. Ductwork: Test all air quantities as specified in Section 230593 - Testing, Adjusting and Balancing. Pressure tests per SMACNA.

C. Registers and Diffusers: Test for proper operation of manually operated control feature. Test all air quantities as specified in Section 230593 – Testing, Adjusting and Balancing.

D. Ductwork Specialties: Test all operable ductwork specialties for proper operation. Check all fire, smoke and fire/smoke dampers to ensure that they are 100% open.

E. Temperature Control: Test all control functions to assure that all systems are controlling as specified or as otherwise necessary and that all controls are adjusted to maintain proper room temperatures. The manufacturer's representative shall perform all tests.

END OF SECTION

VIBRATION ISOLATION AND SEISMIC RESTRAINT FOR PIPING, DUCTWORK 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. All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure.

B. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.

C. All mechanical equipment, piping and ductwork as noted on the equipment schedule, in the specification or as required by code shall be designed to resist seismic forces. Refer to Section 230549 Seismic Restraint for Piping, Ductwork and Equipment

D. This Section includes the following:

1. Vibration Isolation pads.
2. Vibration Isolation mounts.
3. Restrained uni-directional seismic isolation snubber mounts.
4. Spring isolators.
5. Housed seismic spring vibration mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Seismic snubbers.
12. Seismic Restraining braces and cable systems for equipment, piping, and ductwork.
13. Vibration isolation equipment bases.
14. Flexible piping connectors

15. Flexible ductwork connectors

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 CODES AND STANDARDS

A. Provide components conforming to the load requirements of the latest addition of the local building code and the following:

1. 2012 International Building Code with AHJ Amendments

2. American Society of Civil Engineers (ASCE):

3. ASCE 7-10: Minimum Design Loads for Buildings and Other Structures

B. The Manufacturers Standardization Society (MSS):

1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

2. MSS SP-69: Pipe Hangers and Supports - Selection and Application.

3. MSS SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices

4. MSS SP-127: Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application.

C. Mason West Inc. Seismic Restraint Guidelines 2014 Edition

1. OPM-0043-13 for all suspended piping, suspended ductwork and suspended electrical raceways

1.5 PERFORMANCE REQUIREMENTS (NOTE TO EDITOR: LOADING FORCES ARE BASED ON SEISMIC FORCES, EVEN IF WIND FORCES ARE GREATER. REFER TO IBC SECTION 1604.)

A. Seismic-Restraint Loading:

1. Seismic forces for new installations are determined per ASCE/SEI 7-05. Refer to Structural Design for seismic factors and design criteria. Select and submit appropriate values for each piece of equipment and sub-system and material type for the project, and base the seismic calculations on these values.
2. Refer to Section 230549 Seismic Restraint for Piping, Ductwork and Equipment for seismic specific requirements.
3. Coordinate all seismic and load requirements with the registered professional Structural Engineer.

B. Component Importance Factor:

1. Ip=1.0: Standard Occupancies and components associated with Risk Category I, II, and III, including offices and schools.
2. Ip=1.5: Components associated with Risk Category IV Buildings (Essential Services); or for conditions outlined in ASCE 7-10 Section 13.1.3 regardless of Risk Category; or OSHPD 1 (Hospitals) & OSHPD 4 (Correctional Treatment Centers) occupancies in California in accordance with Section 1616A.1.17. Components include, but are not limited to the following:

a. The component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems.
b. The component conveys, supports, or otherwise contains toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established y the authority having jurisdiction and is sufficient to pose a threat to the public if released.

1.6 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Building Structural Limits: The design of supports and restraints shall not exceed the building structure allowable point loads. Coordinate all work with the registered professional Structural Engineer.

D. Special Inspections: Provide structural design and Special Inspections as required by Chapter 17 of the IBC, the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. Per IBC Section 1705 all anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner’s Representative.

1.7 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service or agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For support, vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and where required wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

4. Seismic and Wind-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic and wind restraints include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

d. Preapproval and Evaluation Documentation: By an evaluation service or agency acceptable to the authorities having jurisdiction showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination and plan locations of seismic bracing for HVAC piping, ductwork, and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Qualification Data: Devices shall be selected to meet seismic and support requirements by a registered professional Civil or Structural Engineer licensed in the State of Oregon.

E. Field quality-control Special Inspections:

1. Required for anchorage of equipment in structures assigned to Seismic Design Category C, D, E, or F including

a. Electrical equipment for emergency or standby power systems

b. Piping systems intended to carry flammable, combustible or highly toxic contents in structures.

c. Ductwork intended to contain hazardous materials.

d. Special inspections of mechanical and electrical components

1) Manufacturers of components defined with a component importance factor of 1.5 shall test or analyze the component and its mounting system or anchorage for the design forces experienced in the facility. The manufacturer shall submit a certificate of compliance. Components required to meet this requirement are:

a) Equipment using combustible energy sources (boilers).

b) Motors, transformers, switchgear unit substations, and MCC.

c) Reciprocating and rotating-type machinery.

d) Piping distribution systems 3 inch and larger.

e) Tanks, heat exchangers, and pressure vessels.

e. Isolation system: Shall be part of the special inspection if used as part of the seismic isolation system of components meeting importance factor as defined in the code.

F. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the 2010 OSSC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall be preapproved by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Building Structural Limits: Reference project Structural drawings:

1. The design of the seismic restraints shall not exceed the building structure allowable point loads as reviewed and approved by the project Structural Engineer. The restraint design, whether permanent gravity induced loads or short term earthquake loads, shall not exceed the weakest component or configuration of components within the restraint assembly and/or the building structure limits identified below (The capacities listed below may be increased 1/3 for seismic induced loads).

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS AND APPLICATION

A. Factory Finishes:

1. Standard paint applied to factory-assembled and -tested equipment before shipping.

2. Powder coating on springs and housings.

3. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.

4. Baked enamel or powder coat for metal components on isolators for interior use.

B. Key to Device Schedule: Part 3 of this Section schedules the application of devices described in Part 2 for use with mechanical equipment found on this project. The designation of devices is as follows:

TAG	Description:
P-1	Vibration isolation waffle pad
P-2	Double Deflection Neoprene mount
P-3	Uni-directional Restrained Neoprene snubber mount
S-1	Open spring vibration isolator
S-2	Steel housed seismic spring vibration isolator
H-1	Spring and rubber in shear vibration isolation hanger
Na	Resilient pipe riser support and guide
C-3	Seismic braced non-spring isolation roof curb
B-1	Integral steel fan and motor base
B-2	Concrete filled steel inertia base
F-1	Kevlar/rubber spherical type flexible piping coupling
F-2	Stainless hose flexible piping coupling

F-3	Flexible ductwork connector
A-1	Restrained air mount isolator

2.2 VIBRATION ISOLATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Kinetics Noise Control.
4. Mason Industries.
5. Vibration Eliminator Co., Inc.
6. Vibration Isolation.
7. Vibration Mountings & Controls, Inc
8. Vibro-Acoustics, Inc
9. Vibrex

B. "Waffle" Pads (P-1): Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel base plates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant rubber.
2. Product Selection Basis: Mason SW or Vibro-Acoustics N.

C. Mounts (P-2): Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with base plate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
3. Product Selection Basis: Mason ND or Vibro-Acoustics RD.

D. Restrained Mounts (P-3): All-directional snubber mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

3. Product Selection Basis: Mason BR

E. Spring Vibration Isolators (S-1): Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Base plates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to base plate underside. Base plates shall limit floor load to 500 psig (3447 kPa).

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

7. Product Selection Basis: Mason SLF or Vibro-Acoustics FS.

F. Seismic Restrained Spring Vibration Isolators (S-2): Freestanding, steel, captured spring isolators with seismic or limit-stop restraint.

1. Housing: Steel or cast iron with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled base plate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to base plate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Product Selection Basis: Mason SLR, SSLFH or Vibro-Acoustics SFS.

G. Spring Vibration Hangers (H-1): Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

8. Product Selection Basis: Mason 30N or Vibro-Acoustics SHR.

2.3 PIPE GUIDES AND SUPPORTS

A. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

B. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.4 SEISMIC RESTRAINED ROOF-CURB (C-3)

A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Thybar Corporation.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc
10. Vibro-Acoustics, Inc.

B. General Requirements for Restrained Roof-Curb Rails:

1. Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
2. Curb shall have an anchorage pre-approval “R” number from OSHPD in the state of California attesting to the maximum certified horizontal and vertical load ratings. Brace assemblies and rod clamps shall have an Anchorage Pre-approval "R" Number from OSHPD in the State of California verifying the maximum certified load ratings

C. Lower Support Assembly: Formed sheet-metal. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches (50 mm) of rigid, glass-fiber insulation on inside of assembly.

1. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel base plates, and factory cut to sizes that match requirements of supported equipment.
    a. Resilient Material: Oil- and water-resistant

D. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

E. Product Selection Basis: Thycurb TC-3 or Vibro-Acoustics RTR

2.5 VIBRATION ISOLATION STEEL EQUIPMENT BASES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements provide a comparable product by one of the following:

1. Amber/Booth Company, Inc.

2. California Dynamics Corporation.

3. Isolation Technology, Inc.

4. Kinetics Noise Control.

5. Mason Industries.

6. Vibration Eliminator Co., Inc.

7. Vibration Isolation.

8. Vibration Mountings & Controls, Inc

9. Vibro-Acoustics, Inc.

D. Steel Base (B-1): Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

4. Product Selection Basis: Mason MSL or Vibro-Acoustics SB

E. Inertia Base (B-2): Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

5. Product Selection Basis: Mason KSL or Vibro-Acoustics CIB

2.6 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING, AND DUCTWORK.

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.

2. California Dynamics Corporation

3. Cooper B-Line, Inc.

4. Hilti, Inc.

5. Kinetics Noise Control

6. Loos & Co.

7. Mason Industries

8. Tolco Incorporated

9. Unistrut

10. ISAT, Inc

11. Vibro-Acoustics, Inc.

C. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

D. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.

2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

F. Sway Bracing: All suspended piping, ductwork, conduit and cable trays shall be provided with seismic sway braces in accordance with the applicable codes.

1. Seismic sway braces shall consist of galvanized steel aircraft cables or steel angles/strut channels. Steel aircraft cables shall be pre-stretched to establish a certified minimum modulus of elasticity. Cables braces shall be designed to resist seismic tension loads and steel braces shall be designed to resist both tension and compression loads with a minimum safety factor of 2. Brace end connections shall be steel assemblies that swivel to the final installation angle. Do not mix cable and steel braces to brace the same system. Steel angles or strut channels, when required, shall be clamped to the threaded hanger rods at the seismic sway brace locations utilizing a minimum of two ductile iron clamps. The bracing system shall have an Anchorage Preapproval "OPA" Number from OSHPD in the State of California verifying its capability to resist seismic forces.

2. Basis of Design: Cable brace assemblies shall be Type SCB, steel brace assemblies shall be Type SSBS, rod clamps shall be either Type SRC or UC, pipe clevis braces shall be Type CCB and multiple anchor load distribution brackets shall be Type SLDB all as manufactured by Mason Industries, Inc. or Type RSK cable brace assemblies and Type VAC rod clamps by Vibro-Acoustics.

G. Hanger Rod Stiffener: Steel tube, steel slotted support system sleeve or reinforcing steel angle clamped to hanger rod are acceptable.

H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

L. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.7 FLEXIBLE PIPING CONNECTORS

A. Flexible Spherical Joint (F-1): Flexible spherical joints shall employ peroxide cured EPDM in the covers, liners and Kevlar tire cord frictioning. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16" to 24" may be single sphere. Sizes 3/4" to 1 1/2" may have threaded bolted flange assemblies, one sphere and cable retention. 14" and smaller connectors shall be rated at 250 psi up to 190F with a uniform drop in allowable pressure to 190 psi at 250F. 16" and larger connectors are rated 180 psi at 190F and 135 psi at 250F. Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5 minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods, as control rods are not desirable in seismic work. If control rods are used, they must have 1/2" thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi maximum on the washer area. Expansion joints shall be installed on the equipment side of the shut off valves. 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. All expansion joints shall be installed on the equipment side of the shut off valves. Manufacturer: Mason Industries #SFDEJ, SFEJ, SFDCR, SFU and CR or Vibro-Acoustics EED.

B. Stainless Hoses: (F-2) Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Hoses must have sufficient length to accept 1/2” intermittent motion without failure. Hoses shall be installed

on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Manufacturer: Mason Industries #BSS or Vibro-Acoustics SMP.

2.8 FLEXIBLE DUCTWORK CONNECTORS

A. Flexible ductwork connection (F-3): Flexible fiberglass canvas with fire resistant rated neoprene and UV resistant coating. Stainless steel metal edge banding. Minimum 4" width: DuroDyne "Durolon" or "Neoprene".

PART 3 - EXECUTION

3.1 LOCATION AND APPLICATION OF VIBRATION ISOLATION EQUIPMENT

A. Chart Table 1 schedules vibration devices required for isolation of mechanical equipment provided on the project. Refer to Part 2 above for device specifications.

B. Air Handling Units Equipment Isolation

TABLE 1: EQUIPMENT ISOLATION SCHEDULE - AIR HANDLING UNITS

EQUIPMENT	LOCATION								
	A' CRITICAL (35' - 50' SPAN)			B' UPPER STORY (20' - 35' SPAN)			C' ON GRADE		
	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE
Floor Mounted									
Up to 15 HP	S-1 (1)	3	B-1 (1)	S-1 (1)	3	B-1	S-1 (1)	3	NA
20 HP & Over	S-1 (1)	3	B-1 (1)	S-1 (1)	3	B-2	S-1 (1)	3	NA
Suspended (4)									
Up to 15 HP	H-1	2	B-1(1)	H-1	2	B-1	H-1	2	NA

Notes:
(1) Provided by equipment manufacturer factory installed.
(2) Provide full perimeter steel welded frame below equipment
(3) Provide support per manufacturer's recommendation
(4) Where internally isolated, hard pipe and duct connections to fan are allowed. If not internally isolated, provide F-2 pipe and F-3 duct connectors.

C. Unhoused Fans, Built-up Systems or Cabinet Fans Equipment Isolation

TABLE 1: EQUIPMENT ISOLATION SCHEDULE - UNHOUSED FANS, BUILT-UP SYSTEMS, OR CABINET FANS

EQUIPMENT	LOCATION								
	A' CRITICAL (35' - 50' SPAN)			B' UPPER STORY (20' - 35' SPAN)			C' ON GRADE		
	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE
CENTRIFUGAL FANS									
CL I & II Up to 54-1/2" WD									
Up to 15 HP	S - 2/S - 1	2	B-1	S-2/S-1	2	B-1	S-2/S-1	2	B-1
CABINET FANS and FAN SECTIONS									
Suspended									
Up to 15 HP	H-1	2	NA	H-2	2	NA	H-2	2	NA

Notes:
(1) Provided by equipment manufacturer factory installed.
(2) Provide full perimeter steel welded frame below equipment
(3) Provide support per manufacturer's recommendation
(4) Where internally isolated, hard pipe and duct connections to fan are allowed. If not internally isolated, provide F-2 pipe and F-3 duct connectors.

D. Refrigeration Equipment Isolation

TABLE 1: EQUIPMENT ISOLATION SCHEDULE - REFRIGERATION EQUIPMENT

EQUIPMENT	LOCATION								
	A' CRITICAL (35' - 50' SPAN)			B' UPPER STORY (20' - 35' SPAN)			C' ON GRADE		
	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE
	TYPE	DEFLECTION	TYPE	TYPE	DEFLECTION	TYPE	TYPE	DEFLECTION	TYPE
REFRIGERATION UNITS									
Scroll type Condensing units and Compressors	S-2	2	B-2	S–2/S-1	2	B-1	P-1	2	NA

Notes:
(1) Provided by equipment manufacturer factory installed.
(2) Provide F-2 pipe connections to unit.

3.2 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service or agency acceptable to authorities having jurisdiction. Indicate on Drawings, by details, schedules, or a combination of both, the locations where hanger rods for individual pipes and hanger rods for trapeze hangers require hanger rod stiffeners.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.4 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Comply with manufacturer's recommendations for selection and application of vibration isolation materials and units except as otherwise indicated. Comply with minimum static deflections recommended by ASHRAE, of vibration isolation materials and units where not otherwise indicated.

C. Comply with manufacturer's instructions for installation and load application to vibration control materials and units except as otherwise indicated. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

D. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

E. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

F. Flexible Pipe Connectors: Install on equipment side of shutoff valves.

G. Upon completion of vibration control work, prepare report showing measured equipment deflections for each major item of equipment as indicated. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

H. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

3. Install seismic-restraint devices using methods approved by an evaluation service or agency acceptable to the authorities having jurisdiction. Provide required submittals for components.

I. Piping Restraints:

1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of [40 feet (12 m)., and longitudinal supports a maximum of 80 feet (24 m).

3. Brace a change of direction longer than 12 feet (3.7 m).

J. Install cables so they do not bend across edges of adjacent equipment or building structure.

K. Install seismic-restraint devices using methods approved by an evaluation service or agency acceptable to the authorities having jurisdiction, providing required submittals for component.

L. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolts and mounting hole in concrete base.

M. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

N. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

O. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in 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.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 AIR MOUNTING SYSTEM DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

VIBRATION ISOLATION OF HVAC SYSTEMS

PART 1 GENERAL

1.1 SCOPE

A. Certain systems and components of the project are intentionally designed to avoid vibration problems. Vibration isolation systems are more critical than “standard construction.” The Contractor is cautioned not to overlook these specific components in favor of “standard construction practices” in any pricing, submittal, or construction procedure.

1. Mount rotating and/or reciprocating equipment and associated ductwork on vibration isolators as noted in the Contract Documents. Select, install and adjust isolators to prevent the transmission of objectionable vibration and noise to the building structure.

1.2 RELATED WORK

A. Perform work described in other Specification Sections to meet the product and execution requirements of this Specification.

1. Division 1 – General Requirements.

2. Section 01 86 36 – Ambient Noise Performance Requirements.

3. Division 3 – Concrete.

4. All Division 23 specifications relating to vibration isolated equipment and materials.

5. Section 26 05 48 – Vibration Isolation of Electrical Systems.

1.3 QUALITY ASSURANCE

A. Provide vibration isolators and equipment bases for Divisions 22, 23, 26, 27 from the product line of a single manufacturer unless approved by the project Acoustics Consultant. **Isolators not supplied by the primary vibration isolator manufacturer will be rejected.**

B. The vibration isolator manufacturer's representative shall determine isolator sizes and mountings, and shall provide field supervision and inspection to assure proper installation, adjustment and performance. Representative shall alert the Engineer and project Acoustics Consultant to any isolator selections, which may experience resonance with the approved equipment and upgrade any isolators that are found to resonate with the supported equipment. The Contractor shall include in his bid vibration isolation system elements as recommended by the manufacturer's representative to make a complete, correct, and safe installation. Supply and install any incidental materials needed, even if not explicitly specified or shown in the Contract Documents, without claim for additional payment.

C. A licensed professional engineer, in the employ of the vibration isolation manufacturer, shall certify and stamp the shop drawings stating that all requirements of state and local codes have been met.

1.4 SUBMITTALS

A. Vibration Isolation Mounts and Hangers: In a single consolidated submittal, provide catalog datasheets, shop drawings and other documents as necessary to indicate equipment unit number, isolator type, supported weight, scheduled deflection, **proposed deflection under operating load**, spring free height, spring operating height, spring solid height (at coil bind), and spring diameter for each isolator. **Partial and/or incomplete submittals will be rejected**. Indicate the weight and lowest rotational or reciprocal speed of each piece of isolated equipment. Indicate bridge bearing quality and durometer for elastomers where provided. Use the format below to summarize isolator characteristics for submittal review by the Engineer and project Acoustics Consultant.

B. **SAMPLE SUBMITTAL FORMAT:**

	MOUNT/HANGER
Supported Equipment	P-1
Isolator Type	Mason SLRS-B2-450
Supported Weight	375 LB
Lowest Speed	1500 RPM
Scheduled Deflection	1.5 inch
Operating Deflection	**1.7 inch**
Spring Free Height	4.5 inch
Operating Height	2.8 inch
Solid Height	1.8 inch
Spring Diameter	2.375 inch
Remarks	- -

C. Equipment Bases: Provide detailed drawings for steel bases, sub-bases, and rails showing all steel work, reinforcing method of isolator attachment, and location of equipment attachment bolts.

D. Concrete Inertia Bases: Provide shop drawings showing all steel work, required concrete, and method of isolator attachment, and location of equipment attachment bolts.

E. Shop Drawings: Submit shop drawings and manufacturer's installation instructions for thrust restraints and sway braces wherever they are required.

F. Inspection Report: Upon completion of the installation and after the system is put into operation, the manufacturer's representative shall make a final inspection and submit his report to the Architects and Engineers in writing certifying the correctness of installation and compliance with

approved submittal data. The Contractor shall allow for the cost of this service in his bid.

1.5 DRAWINGS ARE SCHEMATIC ONLY

A. Choose the size and number of mounts and hangers to meet the requirements of this Specification. Provide brackets, rails, bases, braces, snubbers, etc. as needed for a complete and correct installation.

1.6 STANDARDS

A. American Association of State Highway and Transportation Officials Standard Specifications for Highway Bridges (AASHTO), Highway Bridge Specification. See Table B requirements for physical properties of bridge-bearing quality elastomers.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION MANUFACTURERS

A. The following vibration isolation manufacturers will be approved providing mounting systems are in strict accordance with design intent as specified herein:

1. Mason Industries, Inc., Hauppauge, New York.

2. Kinetics Noise Control, Dublin, Ohio.

3. The VMC Group / Amber-Booth Company, Inc., Houston, Texas.

4. The VMC Group / Korfund Dynamics, Bloomingdale, NJ.

B. Since manufacturers' products vary, specific models listed in this Specification may not be approved if they do not meet all requirements in this Specification. Model designations listed herein are intended only as a guide.

2.2 SPRING REQUIREMENTS

A. All steel springs as installed shall have a minimum additional travel to solid (coil bind) equal to 50% of the deflection under operating load.

B. Spring diameter shall be no less than 80% of the compressed height of the spring at operational load.

C. Steel springs shall not take a permanent set when compressed to coil bind.

D. Steel springs shall be color coded to allow positive identification after installation.

2.3 CORROSION RESISTANCE

A. All isolators and associated hardware shall be designed or treated for resistance to corrosion.

2.4 ELASTOMER REQUIREMENTS

A. All elastomeric (rubber, neoprene) components shall be selected for lowest durometer available, Shore A rating. Hardness shall not exceed 50 durometer, Shore A rating, unless approved by project Acoustics Consultant. Use bridge-bearing quality rubber or neoprene meeting AASHTO Highway Bridge Specifications in all elastomeric components.

2.5 TYPE E: RESTRAINED OPEN SPRING FLOOR MOUNT ISOLATORS

A. Restrained open spring floor mount isolators shall have built-in adjustable limit stops for equipment with operating weight significantly greater than empty equipment weight and/or equipment subject to wind forces. Isolators shall be as Type D plus height limiting studs and adjustable nuts, with 1/2” minimum clearance around the studs. Mason model SLR, Kinetics model FLS, Amber-Booth model CT, Korfund model AWRS.

2.6 TYPE G: SPRING AND ELASTOMER-IN-SERIES ISOLATOR HANGERS

A. Spring and elastomer in series isolator hangers shall contain a spring and elastomer in series. The diameters of the spring and the hole in the hanger box shall allow for 15-degree misalignment from vertical before mechanical short circuit occurs. Mason model 30N or DNHS, Kinetics model SRH, Amber-Booth model BSRA, Korfund model RSH.

2.7 TYPE J: THRUST RESTRAINTS

A. Thrust restraints shall be in sets of two or more, and shall be springs with 1/4” minimum elastomeric friction pad between the base plate and the spring. Deflection shall be equal to deflection of isolators supporting the unit being restrained. Provide thrust restraints complete with rods and adjustment nuts, plus angle brackets and backing plates for attachment to the unit being restrained and anchor supports. Mason model WB, Kinetics HSR, Amber-Booth TRK, Korfund HTR.

2.8 TYPE K: SWAY BRACES

A. Sway braces shall be in sets of two or more and shall consist of aircraft cable, elastomers, or elastomer and spring assemblies. Braces shall keep the equipment stable without restricting the free motion of the vibration isolators.

2.9 TYPE M: STEEL BASES

A. Steel bases shall consist of structural steel sections sized, spaced, and connected to form a rigid frame which will not twist, rack, deform, or deflect in any manner to negatively affect the operation of the supported equipment or the vibration isolation mounts. Bases shall be adequately sized to support basic equipment and motors plus any associated pipe/duct elbow supports, electrical control elements, or other components closely related and/or requiring resilient support. Steel bases shall be minimum of 6” thick. Spacing between isolators supporting the steel base shall be a maximum of ten times the thickness of the base.

2.10 TYPE N: STEEL RAILS

A. Steel rail bases shall consist of structural steel sections sized to provide a rigid beam which will not twist, deform, or deflect in any manner which will negatively affect the operation of the supported equipment or the vibration isolation mounts.

2.11 TYPE P: CAPTIVE ELASTOMER WALL MOUNT ISOLATORS

A. Captive elastomer wall mount isolators shall contain an elastomer captured by a metal housing to provide restraint in all directions. Mason model BR, Kinetics model RQ, Korfund model MB.

2.12 TYPE Q: ROOF ISOLATION CURBS

A. Roof isolation curbs shall provide continuous support for equipment using Type E isolators and contain adjustable limits stops to resiliently resist wind forces. Curb construction shall be water-resistant and equipped with flashing to prevent water infiltration. Select curbs for deflection as required in Table 1, within rated capacities of curbs. Mason model RSC, Kinetics model KSR, Amber-Booth model RTIR, Korfund model P.

2.13 FLEXIBLE PIPING CONNECTORS

A. Flexible piping connectors shall be flexible stainless steel metal pipe connectors. Mason model ULCPS.

2.14 FLEXIBLE DUCTWORK CONNECTORS

A. Refer to Section 23 31 00: Air Distribution.

2.15 FLEXIBLE CONDUIT

A. Refer to Section 26 05 48: Vibration Isolation of Electrical Systems.

2.16 VIBRATION ISOLATION TABLE (TABLE 1)

A. Vibration isolation for all equipment shall be provided in accordance with the following Table 1, within rated capacities of isolators, except as otherwise noted in Part 3 of this Specification.

TABLE 1: VIBRATION ISOLATION TABLE

EQUIPMENT TAG	ISOLATOR TYPE	MIN. OPERATING DEFLECTION (IN.)
RTU-1-1, RTU-R-1	Q	1.5
EF-R-1	Q	0.75
FCU-1-1, FCU-1-2	P	0.05
FCU-1-3	G	0.75

CU-R-1, CU-R-2, CU-R-3	E	0.75

PART 3 EXECUTION

3.1 GENERAL

A. Resiliently mount equipment and associated ductwork on or suspended from approved foundations and supports, with isolation mounts and/or hangers as specified herein and as shown on the Contract Documents. Install seismic restraints in strict conformance with the certified shop drawings. Select locations of isolation equipment for ease of inspection and adjustment as well as for proper operation. Contractor shall cooperate with the Architect, Engineer, and project Acoustics Consultant to replace, at no additional cost to the Owner, any isolators that need to be upgraded from what is shown on the Contract Documents if equipment operation results in resonance with building natural frequencies.

3.2 MOUNTS AND HANGERS

A. Align vibration isolators squarely above or below mounting points of the supported equipment.

B. Position vibration isolation hangers as high as possible in the hanger rod assembly **but not in contact with the building structure.** Provide 1” minimum to 3” maximum clearance between hanger housing and structure above. Provide side clearance for hanger housings to allow a full 360-degree rotation about the rod axis without contacting any object.

C. Limit stops shall be out of contact during normal operation.

D. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts and/or pipes.

E. Isolators supporting equipment with center of gravity that is asymmetrical in plan shall be selected for nearly equal deflection under actual load.

F. Install isolators in accordance with manufacturer's instructions.

3.3 THRUST RESTRAINTS

A. Maximum motion shall be 1/4“ under start-up or shut-down conditions for each piece of equipment. Restrain greater motions by approved thrust restraints attached at the centerline of the thrust, and arranged symmetrically on the unit. Anchor the restraints to fixed supports of stiffness greater than the thrust to be countered. Adjust according to manufacturer's instructions.

3.4 ISOLATED SYSTEMS SHALL BE INDEPENDENT

A. Do not hang or support piping, ductwork, conduit or equipment on other equipment, pipes or ductwork installed on vibration isolators. Maintain 2” clearance between isolated equipment and walls, ceilings and other equipment.

3.5 STABILIZE ALL ISOLATED EQUIPMENT

A. Provide resilient sway bracing to solid anchor points to stabilize all resiliently supported equipment and piping in accordance with all requirements of state and local codes.

3.6 TREAT ALL ISOLATION SYSTEMS FOR CORROSION RESISTANCE

A. Repair coatings damaged during installation.

3.7 FACTORY ASSEMBLED EQUIPMENT

A. If internal vibration isolation elements are not approved by project Acoustics Consultant, entire unit shall be mounted on or hung from isolators as described in this Specification. Do not use factory assembled air handling units and/or air conditioning units with factory supplied vibration isolation in conjunction with external spring type vibration isolators described in this Specification. Equipment mounted on spring isolators, which have been supplied with factory installed internal vibration isolation elements, shall have these internal elements rigidly bridged by tightening the shipping bolts. Where units are furnished with internal structural frames and external lugs are of suitable strength and rigidity, install external isolators directly beneath unit. Otherwise, furnish additional Type M or N structural frames and install isolators beneath structural frames to maintain cabinet integrity and bearing alignment.

3.8 DX UNIT REFRIGERANT LINES

A. Install flexible stainless steel metal pipe connectors in two planes 90 degrees to each other in refrigerant lines.

3.9 FLEXIBLE DUCTWORK CONNECTORS

A. Provide flexible ductwork connectors in all ductwork where it is connected to equipment that requires vibration isolation per this Specification. Install between the fan unit and the first duct support. Maintain 3” minimum separation between mated duct segments. Seal joints and seams airtight.

3.10 DUCTWORK ISOLATION

A. All ductwork connected to equipment, that requires vibration isolation per this Specification, shall be vibration isolated according to Table 3.

B. The installation or use of vibration isolators shall not cause any change of position of ductwork which will result in stresses in ductwork connections.

TABLE 3: DUCTWORK ISOLATION TABLE

LOCATION	SUPPORTED FROM	WHERE ISOLATORS ARE REQUIRED	ISOLATOR TYPE	STATIC DEFLECTION

LOCATION	SUPPORTED FROM	WHERE ISOLATORS ARE REQUIRED	ISOLATOR TYPE	STATIC DEFLECTION
Ductwork connected to RTU-1-1	ABOVE	Within 40 feet duct length from equipment	Type G	0.75” minimum.
	BELOW	Within 40 feet duct length from equipment	Type E	

3.11 FLEXIBLE CONDUIT

A. Use to isolate vibration from all equipment requiring vibration isolation per this Specification. Refer to Section 26 05 48: Vibration Isolation for Electrical Systems for installation requirements.

3.12 CONDENSATE DRAIN LINES

A. Condensate drain lines shall not connect rigidly to structure. Install a section of flexible transparent tubing in the drain line between the connection to the equipment and the first point of connection to structure.

END OF SECTION

SEISMIC RESTRAINT FOR PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SUMMARY

A. This Section includes the following:

1. Seismic restraint and support of piping, ductwork and mechanical equipment as required by code and as designed by project registered professional Structural Engineer.

2. Mechanical component supports and the means by which that are attached to the mechanical component shall be designed for the forces and displacements determined in ASCE 7-10 Section 13.3.1 and 13.3.2. Such supports include structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as a part of the mechanical component.

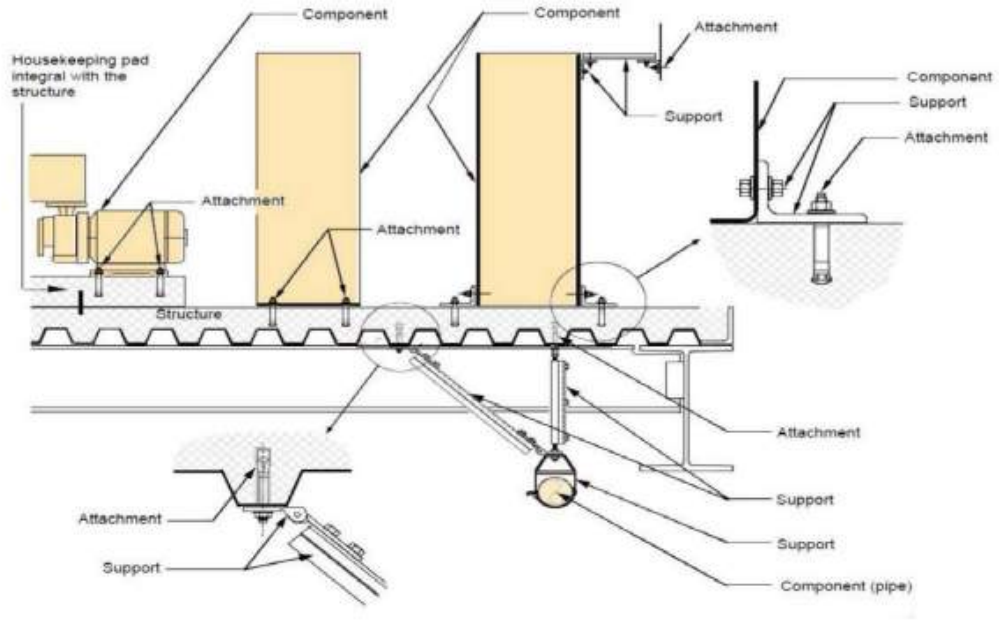
1.3 DEFINITIONS

A. AHJ: Authority Having Jurisdiction

B. IBC: International Building Code with AHJ Amendments.

C. ICC-ES: ICC-Evaluation Service.

D. Mechanical Components: Examples of attachments and supports for a variety of mechanical components are shown as follows:



E. Mechanical Supports: Those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachments to the structure.

F. Mechanical Attachments: Means by which components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic HVAC Materials and Methods

B. Section 230548: Vibration Isolation for Piping, Ductwork and Equipment

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide systems that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Structural Performance: Restraint devices and systems shall withstand the effects of locally defined gravity loads, seismic loads, dead loads, live loads, winds loads and stresses within limits and under conditions indicated according to the Building Code and ASCE 7. Coordinate all support structures and restraint systems with project registered professional Structural Engineer.

C. Special Inspections: Provide structural design and Special Inspections as required by Chapter 17 of the IBC, the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. Per IBC Section 1705 all anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies

shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner's Representative.

D. Codes and Standards: Provide components conforming to the seismic load requirements of the latest addition of the local building code and the following:

1. International Building Code with State Amendments:

a. Section 1613: Standard Occupancies

b. Section 1616: Schools (DSA-SS or DSA-SS/CC Projects in California)

c. Section 1616A: Healthcare (OSHPD and DSA-SS Projects in California)

2. American Society of Civil Engineers (ASCE):

a. ASCE 7-10 - Minimum Design Loads for Buildings and Other Structures

3. Mason West Inc., Seismic Restraint Guidelines

a. OPM-0043-13 for all suspended piping, suspended ductwork and suspended electrical raceways.

1.6 PERFORMANCE REQUIREMENTS

A. Component Importance Factor:

1. Ip=1.0: Standard Occupancies and components associated with Risk Category I, II, and III, including offices and schools.

2. Ip=1.5: Components associated with Risk Category IV Buildings (Essential Services); or for conditions outlined in ASCE 7-10 Section 13.1.3 regardless of Risk Category. Components include, but are not limited to the following:

a. The component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems.

b. The component conveys, supports, or otherwise contains toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established y the authority having jurisdiction and is sufficient to pose a threat to the public if released.

1.7 SUBMITTALS

A. Product Data:

1. Include rated load, rated deflection, and overload capacity for each device or system.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service or agency acceptable to authorities having jurisdiction.

   b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Submit seismic brace product details from the Mason West Seismic Restraint Guidelines detailing compliance with the specifications.

4. Where products from the Mason West Seismic Restraint Guidelines cannot be used, special details must be submitted for approval.

B. Seismic Restraint Calculations

1. Where seismic restraint sizes, spacing and anchorage are included in the Mason West Seismic Guidelines no further calculations are required.

2. Where additional information is required:

   a. Seismic restraint calculations must be provided for all connections to the structure.

   b. Calculations must be stamped by a registered professional Structural Engineer.

1.8 ENGINEERED PIPING SYSTEMS

A. Where the piping system design indicated on the plans utilizes Mason Industries, Inc. - Mason West, Inc. seismic restraint components, vibration isolators, guides, anchors, expansion compensators and flexible connectors the following requirements apply:

1. Mason Industries, Inc. - Mason West, Inc. products must be installed as shown.

2. If product substitutions or design changes are made the contractor must provide certified design of the piping system and meet the following conditions:

   a. Certification must be provided by a registered professional Structural Engineer.

   b. Certification shall include a statement that all systems have been checked for loads and stresses and that no excessive loads or stresses exist.

   c. Forces on all anchors, guides, supports, and restraints must not exceed those shown in the original design unless the structure is checked for the larger loads at no cost to the owner.

B. Where the piping system design is not indicated on the drawings the design is delegated to the contractor with the following requirements for piping certification and analysis:

1. The supports, anchors, guides and seismic braces for systems with significant thermal motion including steam, condensate, high temperature hot water and heating hot water systems must be designed for combined gravity, seismic, pressure and thermal loads.

2. Small diameter pipes (2" diameter and smaller) may not require analysis as determined by the project registered professional Structural Engineer.

3. The results of the analysis shall include reactions at restraints and anchors, maximum pipe displacements and a code compliant report indicating maximum pipe stresses.

4. Where required, seismic restraint components, vibration isolators, guides, anchors, expansion compensators and flexible connectors manufactured by Mason Industries, Inc. and Mason West, Inc. shall be incorporated into the design of the systems.

5. The analysis and design must be performed by a Structural Engineer with 5 years of experience in this field.

1.9 MANUFACTURER AND CONTRACTOR RESPONSIBILITIES

A. All seismic restraints shall be designed by a registered professional Structural Engineer.

B. Seismic restraint layouts for piping and ductwork shall be added to the contractor's shop drawings and shall include:

1. The number, size and location of seismic braces.

2. Maximum support loads and seismic loads at the seismic brace locations.

3. Reference to specific details or pages from the Mason West Seismic Restraint Guidelines.

C. Installations not addressed by the states pre-approval process must be designed, detailed and submitted along with the shop drawings.

D. Submit seismic restraint layout drawings and special details for approval of the project registered professional Structural Engineer per the requirements listed in the Mason West Seismic Restraint Guidelines.

E. Seismic restraint layout drawings shall bear the stamp and signature of the registered professional Structural Engineer who designed the layout of the braces.

1.10 LOADS ON STRUCTURE

A. The responsibility of determining allowable loads on the structure is the sole responsibility of the project registered professional Structural Engineer.

B. Maximum support loads and seismic brace loads on the structure must be less than the maximum allowable loads defined by the project registered professional Structural Engineer, as shown on the plans.

C. Where maximum loads are not listed on the plans or the maximum allowable loads cannot be met, any additional support steel required to reduce support and seismic bracing loads on the structure shall be designed by the project registered professional Structural Engineer.

D. Mechanical component supports and the means by which that are attached to the component shall be designed for the forces and displacements determined in ASCI 7-10 Section 13.3.1 and 13.3.2. Such supports include structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as a part of the mechanical component.

E. Mechanical supports are those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners that transmit loads between nonstructural components and their attachments to the structure.

F. Mechanical attachments are the means by which components or supports of nonstructural components are secured or connected to the seismic force-resisting system of the structure. Such attachments include anchor bolts, welded connections, and mechanical fasteners.

PART 2 - PRODUCTS

2.1 INTENT

A. All seismic restraints described in this section shall be the product of a single manufacturer.

B. Mason Industries products are the basis of these specifications; products of other manufacturers may be submitted for review provided their systems strictly comply with the specifications.

2.2 SEISMIC SWAY BRACING

A. Seismic sway braces shall consist of galvanized steel aircraft cables, steel angles or steel struts.

B. Cables braces shall be designed to resist seismic tension loads and steel braces shall be designed to resist both tension and compression loads. Brace end connections shall be steel assemblies that swivel to the final installation angle.

C. Cable brace assemblies shall have published strength and stiffness ratings based on testing per FM-1950 standards.

D. Angle or strut bracket assemblies shall be FM Approved except as noted below.

E. Steel angles or struts, when required, shall be clamped to the threaded hanger rods at the seismic sway brace locations utilizing a minimum of two ductile iron clamps.

F. Cable brace bracket assemblies shall be Type SCB or SCBH. Solid brace bracket assemblies shall be Type SSB-FM, SSBS-FM or SHB-FM. All bracket assemblies shall have published strength and stiffness values based on testing per FM-1950.

G. Rod clamps shall be Type SRC or UCC.

H. All brace components shall be as manufactured by Mason Industries, Inc. and Mason West, Inc. as included in the Mason West Seismic Restraint Guidelines.

PART 3 - EXECUTION

A. Contractor's Statement of Responsibility: Each contractor responsible for installing a Designated Seismic System or any seismic resisting component must submit a statement of responsibility prior to the commencement of work to include acknowledgment of awareness of the need for Special Inspections.

B. All seismic restraint systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.

C. Installation of seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.

D. No connections between the piping or ductwork and the building structure shall be made that degrades the seismic restraint system herein specified.

E. Any conflicts with other trades due to inadequate space or other unforeseen conditions should be brought to the attention of the Owner's Representative prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

END OF SECTION

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. Owner (University of Oregon) shall hire out or perform all TAB related work on this project noted in specification and related specifications. (This scope of work shall not be bid out under the General or Mechanical Contractor.)

B. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 WORK RELATED IN OTHER SECTIONS

A. Section 230500: Basic Materials and Methods

B. Section 230900: Controls and Instrumentation

C. Section 233113: Air Distribution

D. Division 26: Electrical.

1.3 SUMMARY

A. Scope: Extent of testing, adjusting and balancing work required by this Section is indicated on the drawings, in schedules, and by the requirements of this Section, and Section 230500 -Basic Mechanical Requirements.

B. Systems: Testing, adjusting and balancing specified in this Section shall include, but not be limited to, the following systems:

1. Air handling systems including supply, return and exhaust.

2. Air distribution ductwork including supply, return and exhaust.

3. Automatic temperature control system.

4. General exhaust systems.

5. Domestic hot water recirculation piping.

6. Underfloor air distribution system air leakage. (if applicable)

7. Instruction of Owner's personnel for future balancing of systems.

C. Reference Standards

1. ASHRAE-Standard 111-2008 Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, and Air Conditioning Systems.

2. ASHRAE - 2011 HVAC Applications Handbook: Chapter 38--Testing, Adjusting and Balancing.

3. ASHRAE 90.1-2010 Energy Standard for Buildings Except Low-Rise Residential Buildings, Chapter 6.

4. AABC-National Standards for Total System Balance.

5. NEBB-Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

6. SMACNA-HVAC Systems-Testing, Adjusting and Balancing.

7. SMACNA-HVAC Air Duct Leakage Test Manual.

8. Sheet Metal Industry--Testing, Adjusting, Balancing Bureau (TABB) Certified Technician Standards, Procedures and Specifications.

9. American National Standards Institute (ANSI): Comply with the following:

   a. S1.4Specification For Sound Level Meters.

   b. S1.11Specification For Octave-Band and Fractional-Octave-Band Analog and Digital Filters

10. Chapter 4 of applicable Mechanical Code.

1.4 QUALITY ASSURANCE

A. Contractor's Qualifications: A specialist certified by the National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) with at least 5 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, who is not the installer of the system to be tested and is otherwise independent of the project. Testing, adjusting, and balancing shall be performed by a certified NEBB technician or a certified AABC technician under direct field supervision of a Certified NEBB Supervisor or a Certified AABC Supervisor. Testing and balancing agency must submit qualifications for review and approval prior to acceptance for work.

B. Penalty: The Contractor shall submit the name of the organization he proposes to employ for approval within 30 days after contract award. If the Contractor fails to submit the name of an acceptable agency within the specified time, a firm may be selected to accomplish the work, and this selection shall be binding upon the Contractor at no additional cost.

C. Retainages: In addition to any other sums retained or withheld pursuant to the provisions of this Contract, the amount of dollars will be withheld from payments to the contractor until such time as the work has been completed and accepted. In no event will this amount be paid to the Contractor prior to 60 days following acceptance of the project; during such time, the Contractor shall investigate and correct any reported deficiencies unless such deficiencies are a result of unauthorized tampering by building occupants.

D. Calibration of Testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over 6 months.

E. Testing and balancing agency, as part of its contract, shall act as authorized inspection agency responsible to Consulting Engineer and Owner, and shall list all items that are installed incorrectly, require correction, or have not been installed in accordance with contract Drawings and Specifications, pertaining to air distribution, cooling and heating systems. The testing and balancing agency is required to provide written reports of all deficiencies and proposed recommendations to the Owner' Representative, Contractor, Architect and Engineer.

F. The testing and balancing agency shall provide with his bid a performance guarantee covering all phases of the work as herein specified.

G. The General and Mechanical Contractors shall cooperate with the selected testing and balancing agency in the following manner:

1. Provide sufficient time before final completion dates so that tests and balancing can be accomplished.

2. The various system installers, suppliers and contractors shall provide all required materials, labor and tools to make corrections when required without undue delay. Install balancing dampers as required by testing and balancing agency.

3. The contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of the same during each working day of testing and balancing.

4. Testing and balancing agency shall be kept informed of any major changes made to the system during construction, and shall be provided with a complete set of Record Drawings.

5. The General Contractor shall make space and other facilities available to the testing and balancing agency to enable their work to progress. The General Contractor shall schedule the work of other trades to avoid conflicts with this work.

1.5 SUBMITTALS

A. Conform to the Submittals requirements of Division 01.

B. Forms: The Contractor shall deliver a complete copy of either NEBB or AABC standard forms for testing and balancing work associated with the project. These forms shall serve as specific

guidelines for producing final test report. Hybrid or non-standards forms are not acceptable. Data shall include, but not be limited to, a title page with building information, instrument lists, air flows, water flows, temperatures, sound levels, capacities, nameplate data.

C. Test Reports: Provide six (6) certified test reports, signed by the test and balance supervisor who performed the work. The final reports shall include identification and types of instruments used, and their most recent calibration date, and key plans identifying all inlets and outlets. Final test reports shall be typed. Hand written reports are not acceptable.

D. Maintenance Data: Include, in maintenance manuals, copies of certified test reports and identification of instruments.

E. Qualifications: The Contractor shall submit the certified individual qualifications of all persons responsible for supervising and performing the actual work and the name of the certifying engineer. Provide a reference list of five (5) similar size projects with contact person and telephone number.

1.6 AGENDA

A. Agenda: A preliminary report and agenda shall be submitted and approved prior to the start of testing and balancing work.

1. Review plans and specifications prior to installation of any of the affected systems, and submit a report indicating any deficiencies in the systems that would preclude the proper adjusting, balancing, and testing of the systems.

2. The agenda shall include a general description of each air and water system with its associated equipment and operation cycles for heating and cooling.

3. The agenda shall include a list of all air and water flows to be performed at all mechanical equipment.

4. The agenda shall incorporate the proposed selection points for sound measurements, including typical spaces as well as sound sensitive areas such as conference rooms.

5. The agenda shall also include specific test procedures and parameters for determining specified quantities (e.g. flow, drafts, sound levels) from the actual field measurements to establish compliance with contract requirements. Samples of forms showing application of procedures and calculations to typical systems shall be submitted.

6. Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application (by sketch) and factors for:

a. Air terminal configuration.

b. Flow direction (supply or exhaust).

c. Velocity corrections.

d. Effective area applicable to each size and type of air terminal.

e. Density corrections.

7. The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date.

1.7 JOB CONDITIONS

A. General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met.

1. Work has been completed and is operable. Ensure that there is no latent residual work yet to be completed on the tested equipment.

2. Work scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials.

3. All architectural openings (doors, windows, and other openings) which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal states.

4. All related mechanical systems which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal operating conditions.

PART 2 - PRODUCTS

2.1 TEST HOLES

A. Test holes shall be provided in ducts, housings and pipes as necessary for the proper air measurements and to balance systems. At each location where ducts or plenums are insulated, test holes shall be provided with an approved extension with plug fitting.

2.2 PATCHING MATERIALS

A. Material: Seal, patch and repair ductwork, piping and equipment drilled or cut for testing purposes.

1. Plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

2. Piping shall be capped with materials the same as the piping system.

3. Insulation shall be neatly hemmed with metal or plastic edging, leaving test points visible for future testing.

2.3 TEST INSTRUMENTS

A. Standards: Utilize instruments and equipment of type, precision, and capacity as recommended in the NEBB "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and AABC manual MN-1.

B. Test Instruments: All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. Each test instrument shall be calibrated by an approved laboratory or by the manufacturer. A representative has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

C. Additional Instruments: Permanently installed measuring instruments, such as temperature and pressure gauges, shall be checked against transfer standard instruments. Any instrument which does not meet specification requirement shall be replaced or recalibrated.

D. Cone Instruments: The Contractor shall employ manufactured enclosure type cones, capable of air volume direct readings, for all diffuser/grille/register air flow measurements. The readout meters shall meet calibration requirements.

PART 3 - EXECUTION

3.1 PROCEDURES AND INSTRUMENTS, GENERAL

A. Requirements: All systems and components thereof shall be adjusted to perform as required by drawings and specifications.

B. Test Duration: Operating tests of heating and cooling coils, fans, and other equipment shall be of not less than four hours duration after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda.

1. All instruments shall be applied in accordance with the manufacturer's certified instructions.

2. All labor, instruments, and appliances required shall be furnished by the Contractor. Permanently installed instruments used for the tests (e.g., flow meters and Btu meters) shall not be installed until the entire system has been cleaned and ready for operation.

3.2 DUCT SMOKE DETECTORS

A. The testing and balancing agency shall direct the placement of all duct mounted smoke detectors.

1. Obtain information from the Contractor who is to furnish the smoke detectors on the proper device placement and installation limitations and on the proper differential pressure across the sampling tubes of the duct detectors.

2. Based on the submitted manufacturer's installation guidelines indicate the proper mounting location to the installing Contractor.

B. After the installation of all smoke detectors test them again in the final installation position and report differential pressures.

3.3 AIR SYSTEM PROCEDURES

A. Adjustments: Adjust all air handling systems to provide approximate design air quantity to or through, each component, and to maintain stable and comfortable interior temperatures, free of drafts or stagnant conditions. Adjusting and balancing of all systems shall be conducted during periods of the year approximating maximum seasonal operation.

B. Equalizers: Equalizing devices shall be adjusted to provide uniform velocity across the inlets (duct side for supply) of terminals prior to measuring flow rates.

C. Balance: Flow adjusting (volume control) devices shall be used to balance air quantities (i.e., proportion flow between various terminals comprising system) to the extent that their adjustments do not create objectionable air motion or sound (i.e., in excess of specified limits).

1. Balancing between runs (submains, branch mains, and branches) generally shall be accomplished by flow regulating devices at, or in, the divided-flow fitting.

2. Restriction imposed by flow regulating devices in or at terminals shall be minimal.

3. Final measurements of air quality shall be made after the air terminal has been adjusted to provide the optimum air patterns of diffusion.

D. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds or axial-flow fan wheel blade pitch. Damper restriction of a system's total flow may be used only for systems with direct-connected fans (without adjustable pitch blades), provided system pressure is less than 1/2-inch W.G. and sound level criteria is met.

E. Air Measurement: Where air quantity measuring devices are specified in other sections such systems shall be used as a cross-check of portable measuring equipment.

1. Except as specifically indicated herein, pitot tube traverses shall be made of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform to the ASHRAE "Handbook Fundamentals Inch Pound Edition."

2. For ducts serving modular office areas with movable partitions, which are subject to change, pitot tube traverses may be omitted provided the duct serves only a single room or space and its design volume is less than 2000 cfm. In lieu of pitot tube traverses, airflow in the duct shall be determined by totaling volume of individual terminals served, measured as described herein.

3. Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), air quantity may be determined by measurements at terminals served.

F. Test Holes: Test holes shall be in a straight duct, as far as possible downstream from elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.

G. Air Terminal Balancing: Generally, measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing. Measurement of air quantities at each type of air terminal (inlet and outlet) shall be determined by the method approved for the balancing agenda. Laboratory tests shall be conducted to prove of methodology when so directed. Such tests shall be conducted in conformance with applicable ASHRAE or American Society of Mechanical Engineers (ASME) codes and shall be made at no cost.

H. Air Motion: Air motion and distribution shall be as specified and indicated on drawings. The Contractor at no additional cost shall, in addition to air motion measurements, make smoke tests wherever requested to demonstrate the air distribution from air terminals.

I. Air system test and balance procedures shall include, but not be limited to the following requirements:

1. Test and adjust blower RPM to design requirements.

2. Test and record motor full load amperes.

3. Make pitot tube traverse of main supply ducts and obtain design CFM at fans.

4. Test and record system pressures, suction and discharge.

5. Test and adjust system for design recirculated air, CFM.

6. Test and adjust system for design CFM outside air.

7. Test and record entering air temperatures.

8. Test and record leaving air temperatures.

9. Adjust all supply, return and exhaust air ducts to proper design CFM.

10. Adjust all zones to proper design CFM, supply and return.

11. Test and adjust duct systems and each diffuser, grille, and/or register to within 10% of design requirements.

12. Each grille, diffuser and register shall be identified as to location and area.

13. Size, type and manufacturer of VAV boxes, diffusers, grilles, registers and all tested equipment shall be identified and listed. Manufacturer's ratings on all equipment shall be used to make required calculations.

14. Readings and tests of diffusers, grilles and registers shall include required FPM velocity and test resultant velocity, required CFM and test resultant CFM after adjustment.

15. In cooperation with the control manufacturer's representative, setting adjustments of automatically operated dampers to operate as specified, indicated, and/or noted. Testing agency shall check all controls requiring adjustment by control installers. Room thermostats shall be checked for cooling and heating response.

16. All diffusers, grilles and registers shall be adjusted to minimize drafts in all areas.

17. Adjust overall system balances to allow all self-closing exterior doors to close from any open position. Maximum interior air pressure in all operational modes shall not exceed 0.05" static pressure relative to the outside air pressure. Comply with chapter 10 of the Building Code to assure that self-closing doors with release with a maximum force of 15 lbs.

18. As part of the work of this contract, the HVAC contractor shall make any changes in the pulleys, belts and dampers or the addition of dampers required for correct balance as recommended by air balance agency, at no additional cost to Owner.

19. After air balancing is completed and RPM determined, HVAC Contractor shall provide fixed pitch pulleys.

20. All mixing boxes, VAV air valves, control dampers, smoke dampers and similar devices which operate at 100% shut off shall be tested for leakage.

21. Variable Air Volume Fan Systems: The primary balancing mode is 100% outside air with all terminal boxes on a full call for cooling. Also check and record performance at minimum outside air with all terminal boxes on call for full cooling and at minimum outside air with all terminal boxes on call for full heating. Verify that the systems are operating on a stable part of the fan curves in each mode. Record final duct static controller settings

22. AHU 2-2 exhaust sequence of operation. This AHU has a separate refrigerant purge sequence of operation where the supply ductwork serves an exhaust function. Balance exhaust fan airflow setpoint to maintain design airflow setpoints (same as supply design airflow) at mezzanine level diffusers. Provide this information & exhaust fan setpoint in TAB report.

3.4 AIR SYSTEM DATA

A. Report: The certified report shall include for each air handling system the data listed below.

1. Equipment (Fan or Factory Fabricated Station Unit):

a. Installation data

1) Manufacturer and model

2) Size

3) Arrangement, discharge and class

4) Motor hp, voltage, phase, cycles, and full load amps

5) Location and local identification data

b. Design data

1) Data listed in schedules on drawings and specifications.

c. Fan recorded (test) data

1) cfm

2) static pressure

3) rpm

4) motor operating amps

5) motor operating bhp

2. Duct Systems:

a. Duct air quantities (maximum and minimum) - main, submains, branches, outdoor (outside) air, total air, and exhaust:

1) duct size(s)

2) number of pitot tube (pressure measurements)

3) sum of velocity measurements (Note: Do not add pressure measurements)

4) average velocity

5) recorded (test) cfm

6) design cfm

b. Individual air terminals

1) terminal identification supply or exhaust, location and number designation

2) type size, manufacturer and catalog identification applicable factor for application, velocity, area, etc., and designated area

3) design and recorded velocities - fpm (state "core," "inlet," etc., as applicable)

4) design and recorded quantities - cfm (deflector vane or diffusion cone settings)

3.5 DUCTWORK AIR LEAKAGE TESTING

A. Test and balance agency shall perform active air flow testing of ductwork systems or sections of ductworks. Agency shall inspect and confirm that all ductwork is sealed per the specification requirements prior to performing any testing. Calculate maximum allowable air leakage by system based on total design air flow rate. Maximum allowable system leakage shall not exceed 5%. Test a random sample of 10% of the ductwork. If any ductwork within the sample fails to meet the criteria than an additional 10% (20% total) sample must be measured. If any ductwork within this second 10% sample fails than 100% of all ductwork must be tested and verified to have a leakage rate than does not exceed the maximum allowable limit.

B. Ductwork systems to be leakage tested shall include:

1. Testing shall be performed at 1.5 times the peak design outlet static pressure from the air handling unit/fan, but not greater than the maximum SMACNA pressure rating of the ductwork construction classification. Testing is not required of flexible ductwork or ductwork downstream of VAV terminal units.

2. Leakage through manufactured products, such as dampers, fire smoke dampers and terminal units may be excluded from the leakage calculations based on manufacturer stated values, at pressure, or these units may be temporarily sealed with painter's tape during testing to seal any openings and must be removed after testing.

3. Supply air ductwork from outlet of the air handling unit/fan to inlet side of terminal units or connection to flexible ductwork.

4. All supply, return and exhaust air ductwork located outside the building envelope.

5. Return and exhaust air ductwork located in unconditioned spaces from inlet of the air handling unit/fan to the ductwork terminations upstream of each return air grille.

6. Laboratory and fume hood exhaust air ductwork from inlet of the air handling unit/fan to the connection at the remote exhaust air grille or fume hood connection.

7. Kitchen exhaust air ductwork from inlet of the exhaust fan to the connection at the remote exhaust hood.

C. Ductwork installer shall prepare ductwork for pressure testing as deemed appropriate to maintain construction schedule. Ductwork may be tested as total systems or in sections. Sectional testing will require documentation to prove the totalized system leakage is within allowable range of entire system. Ductwork inlets and outlets may be temporarily sealed airtight with plastic, or other means, to facilitate testing pressures.

D. Testing may occur through ductwork devices such as balancing dampers, smoke fire dampers and coils. Manufacturer provided air leakage allowances for such devices may be excluded from duct leakage measurement but must be documented in final report.

E. Perform all testing utilizing a duct leakage testing system, Oriflow Duct Leakage Tester or equal, with calibrated fan, orifice, gauges, ductwork, pressure tips and tubing.

3.6 SOUND TEST PROCEDURES

A. Scope: Tests of sound levels shall be made at each selection point included in the agenda.

B. Timing: Sound level measurements shall be taken at times when the building is unoccupied, or when activity in surrounding areas and background noise level in areas tested are at a minimum and relatively free from sudden changes in noise levels.

1. Measurements shall be taken with all equipment turned off, except that being tested.

2. The required sound levels shall be measured at any point within a room not less than 6 feet from an air terminal or room unit, and not closer than 3 feet from any floor, wall, or ceiling surface.

C. Meters: Sound levels shall be measured with a sound meter complying with ANSI S1.4. The "A" scale shall be used to measure over all sound levels. To determine the specified octave band levels, the above sound level meter, set on "C" scale, shall be supplemented by an octave band analyzer complying with ANSI S1.11.

D. Equipment Components: The "Equipment Component" of room sound equals LPt-C. The "Equipment Component" of room sound (noise) levels shall be determined for each of eight octave bands as follows:

1. Measure room sound pressure level "LPb" with equipment to be tested shut off.

2. Measure room sound pressure level "LPt" with equipment to be tested turned on.

3. Calculate LPt-LPb; if this value is less than 1, applicable test must be rerun with lower background level (LPb) unless LPt is within sound pressure level specified for equipment.

4. Determine "c" from the table below.

LPt-LPb (db)	c (db)
1	7
2	4
3	3
4 to 4- ½	2
5 to 5- ½	1 – ½
6 to 7- ½	1
8 to 12	½
over 12	0

3.7 SOUND LEVEL DATA

A. Report: certified report shall record data on sound levels, taken at each selected location, as follows:

1. Source of sound and location.

2. Diagram or description of relationship of sound source to measuring instrument.

3. "A" scale readings equipment being tested turned off (ambient) equipment being tested turned on (operating conditions).

4. Readings at each specified octave band frequency equipment being tested turned off (ambient) equipment being tested turned on (operating conditions).

5. "Equipment Components" of sound (noise) levels with applicable calculations per "Sound Test Procedures".

6. Graph showing relationship between pressure levels specified and recorded readings

B. Retest: Subsequent to any correctional construction work, such as acoustic corrections, measurement shall be made to verify that associated air and water quantities, as previously measured, have not been disrupted.

1. Certified report shall record all sound data, and their locations, after final adjustments of air and water systems involves.

3.8 CERTIFIED REPORTS

A. Submittals: Six (6) copies of the reports described herein, covering air and water system performance, air motion (fpm), and sound pressure levels, shall be submitted prior to final tests and inspection.

B. Instrument Records: Types, serial numbers, and dates of calibration of all instruments shall be included.

C. Reports: Reports shall conspicuously identify items not conforming to contract requirements, or obvious malfunction and design deficiencies.

D. Certification: Certification shall include checking of adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

3.9 FINAL COMMISSIONING TESTS, INSPECTIONS AND ACCEPTANCE

A. Scope: Test shall be made to demonstrate that capacities and performance of air and water systems comply with contract requirements.

1. At the time of final inspection, the Contractor shall recheck, random selection of data (water and air quantities, air motion, and sound levels) recorded in the certified report. In addition, all courtrooms, auditoriums, and conference rooms shall be rechecked.

2. Points and areas for recheck shall be selected by the commissioning team.

3. Measurement and test procedures shall be the same as approved for work forming basis of certified report.

4. Selections for recheck (specific plus random), in general, will not exceed 25 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

B. Retests: If random tests elicit a measured flow deviation of 10 percent or more from, or a sound level of 2 db or more greater than, that recorded in the certified report listings, as 10 percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made, all at no additional cost. Retainage time shall be based on the date of the final acceptance of the certified report.

C. Marking of Settings: Following final acceptance of certified reports, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the Contractor so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after final acceptance.

END OF SECTION

EQUIPMENT SOUND LEVEL LIMITS

PART 1 GENERAL

1.1 SUMMARY

A. Sound levels for air handlers, VAV terminals, fan coils, fans, and condensing units shall be within the scheduled limits. Equipment on this project is stringently designed to avoid noise problems. Sound level specifications are more exacting than for “standard construction”. The Contractor is cautioned not to overlook these specific requirements in favor of “standard construction practices” in any pricing, submittal or construction procedure.

1.2 RELATED WORK

A. Perform work described in other Specification Sections to meet the product and execution requirements of this Specification.

1. Division 1 – General Requirements.

2. Section 01 86 36 – Ambient Noise Performance Requirements.

3. Section 23 31 13 – Air Distribution.

4. Section 23 34 13 – Fans.

5. Section 23 74 15 – Packaged Rooftop HVAC 1.5 – 20 Tons

6. Section 23 81 25 – Mini Split Air Conditioning Units

1.3 SUBMITTALS

A. Submit equipment sound power/pressure level data in decibels (re 10^{-12} W) for each condition and octave band center frequency indicated in Parts 0 and 0 of this Specification. Submitted levels shall represent maximum sound power/pressure levels derived from points of operation between and including minimum and maximum design capacities and at the maximum external static pressure indicated in the Contract Documents.

B. Submit a certification that the data were developed in accordance with standards approved by Part 1.4 of this Specification, including which standards were used and any methods of data interpolation (e.g. Specific Sound Power Level Method or Generalized Sound Power Spectrum; AMCA 301-06).

C. Submit the fan curve and the design point of operation for each fan.

D. Submit a description of the proposed testing methods, standards, acoustics test facility, and test configuration drawings for conducting witnessed sound power testing as required by Part 1.7 of this Specification.

E. Diffusers, Registers, and Grilles

1. Submit NC rating for each and every device, using the submittal format shown below.

Any submittal of catalog charts without detailed project-specific information in the specified format will be rejected. Submittal must indicate the assumed room effect used to convert from octave band sound power levels to NC ratings.

2.

Example	Sample Data
Air Outlet/Inlet Device Tag	Room Name #100, SA-4
CFM	500
Device Size	24x24
Neck size (where appl.)	14"
Model Number	TMSA
NC rating of device	NC-20
Assumed room effect	8 dB
RC from Section 01 86 36 –	RC 25(N)
Accessories included	integral balancing damper, air straighteners, etc.

1.4 STANDARDS

A. Sound power levels for air handling units and other ducted air moving equipment shall be based upon test data taken in accordance with AHRI Standard 260-2012: Sound Rating of Ducted Air Moving and Conditioning Equipment, AMCA Standard 300-08: Reverberant Room Method for Sound Testing of Fans, or AMCA Standard 320-08: Laboratory Methods of Sound Testing of Fans Using Sound Intensity.

B. Alternately, inlet and discharge levels for ducted fans may be taken in accordance with ASHRAE Standard 68-1997 (AMCA 330-97): Laboratory Method of Testing to Determine the Sound Power in a Duct.

C. Fan sound power level data development shall comply with AMCA Standard 301-06: Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

D. Sound power level data for VAV terminals shall be certified in accordance with AHRI 880-2011: Air Terminals.

E. NC ratings for diffusers, registers, and grilles shall be based upon laboratory test data taken in accordance with ASHRAE Standard 70-2006: Method of Testing for Rating the Performance of Air Outlets and Inlets.

1.5 TERMINOLOGY

A. Unit shall mean the entire device, including fans, casing, plenums, integral silencers, etc.; as

distinguished from bare fans (no casing).

B. Discharge and inlet sound power levels shall be as measured at the cabinet outlet/inlet based upon supply fan, return fan, and/or VAV terminal performance. Reported levels shall include the effects of plenums, acoustical lining, and outlet/inlet locations and sizes in the cabinet, as applicable. Units tested with ducted outlets/inlets shall be adjusted for end reflection effects.

C. Radiated sound power levels shall be total unit casing radiated sound.

1.6 GUARANTEE

A. Manufacturer shall certify that the units operated at the design parameters shall generate sound not exceeding the sound power/pressure levels scheduled. If the units are determined to operate in excess of the specified limits, the Manufacturer shall correct the condition at no expense to the Owner and shall pay any expenses incurred in review by the Architect, Engineer, and project Acoustics Consultant.

1.7 WITNESS TEST

A. Conduct sound power tests of the following units at the design points of operation before they are shipped: RTU-1-1. Tests shall be conducted in accordance with one or more standards identified in Part 1.4.A of this Specification. Manufacturer shall include the costs for time and expenses of the project Acoustics Consultant to witness these tests. No units shall be shipped before approval is given by the Architect based upon the results of these witness tests.

PART 2 SCHEDULES

2.1 SOUND POWER LEVEL LIMITS:

Equipment Tag	**Source**	**Octave Band Center Frequency (Hz)**							
		63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
		Sound Power Level Limit (dB)							
RTU-1-1	Discharge: Inlet:	85 89	86 89	89 81	87 80	83 83	80 81	76 78	73 75
RTU-R-1	Discharge: Inlet:	89 87	89 85	91 81	92 77	87 79	84 78	78 75	71 72
EF-R-1	Inlet:	82	79	71	64	63	57	46	47
4” TU (150cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	69 56	64 50	61 47	58 40	54 37	51 33	- -

EQUIPMENT SOUND LEVEL LIMITS

5” TU (250cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	71 62	69 52	63 45	61 39	54 35	51 31	- -
6” TU (400cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	74 61	72 58	67 50	66 41	57 38	54 33	- -
7” TU (550cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	74 62	72 57	67 51	64 43	60 39	57 35	- -
8” TU (700cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	74 64	71 59	66 50	64 43	59 39	56 38	- -
9” TU (900cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	73 60	70 56	68 50	67 44	62 39	58 36	- -
10” TU (1100cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	74 61	69 65	68 50	67 45	62 39	58 36	- -
12” TU (1600cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	76 64	70 58	70 53	69 49	64 42	59 39	- -
14” TU (2100cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	76 66	70 61	68 55	68 48	63 44	63 43	- -
16” TU (2800cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	77 67	71 63	70 58	69 50	64 46	61 42	- -
24”x16” TU (5300cfm @ 1.5” w.g.)	Discharge: Radiated:	- -	83 73	81 70	79 70	77 65	74 60	79 55	- -

2.2 SOUND PRESSURE LEVEL LIMITS

Equipment Tag	**Source**	**Octave Band Center Frequency (Hz)**							
		63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
		Sound Pressure Level Limit (dB)							
FCU-1-1, FCU-1-2 on high speed @ 1m horizontally and 1m vertically	Total:	43	42	44	40	41	39	33	23

EQUIPMENT SOUND LEVEL LIMITS

CU-R-1, CU-R-2 @ 1m horizontally and 1.5m vertically	Total:	53	52	51	46	46	41	38	29

2.3 DIFFUSERS, REGISTERS, AND GRILLES

A. For spaces listed in Section 01 86 36: Ambient Noise Performance Requirements the NC ratings for diffusers, registers and grilles shall not be greater than the lowest RC listed minus 3 decibels, where an 8 decibel room effect is assumed. Where a 10 decibel room effect is used, the NC rating shall not be greater than the lowest RC minus 5 decibels. Diffusers, registers, and grilles shall not have integral dampers for spaces listed in Section 01 86 36.

PART 3 EXECUTION

3.1 REMEDIES

A. Replace equipment or provide noise reduction accessories (attenuators, plenums, lining, etc.) as necessary to achieve allowable sound power/pressure levels. These remedies shall be reviewed by the project Acoustics Consultant prior to implementation.

END OF SECTION

HVAC INSULATION

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall include, but not necessarily be limited to, providing insulation for the following:

1. Ductwork

   a. All supply air ductwork, unless otherwise shown on drawings.

   b. All return air ductwork, unless otherwise shown on drawings.

   c. Acoustical duct lining, in vertical/horizontal supply and return ducts within twenty feet (20') of air handling equipment and where otherwise shown on drawings.

   d. Outside air ductwork in return plenums, mechanical rooms and in freezing climates

   e. Exhaust air ductwork in cold air plenums.

2. Piping:

   a. Refrigerant Systems

3. Plenums and equipment rooms, as noted.

B. Types of mechanical insulation specified in this Section include the following:

1. Fiberglass pipe insulation.

2. Cellular glass pipe insulation.

3. Calcium silicate pipe insulation.

4. Flexible elastomeric closed cell insulation

5. Fiberglass duct insulation.

6. Polymide Foam Acoustic duct liner.

7. Cellular glass duct insulation.

8. Flexible unicellular duct insulation.

9. Calcium silicate duct insulation.

10. Fiberglass equipment insulation.

11. Calcium silicate equipment insulation.

12. Cellular glass equipment insulation.

13. Flexible unicellular equipment insulation.

14. Insulation jackets.

15. Insulation accessories.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 220501: Plumbing.

B. Section 230500: Basic Materials and Methods.

C. Section 232113: HVAC Piping, Valves and Specialties.

1.4 DEFINITIONS

A. Ambient: The air temperature to be maintained in a conditioned room. Typically between 70°F and 78°F.

B. Insert: Spacer placed between the pipe support system and the piping to allow for the space required for insulation.

C. Insulation Group (IG): Definition of Insulation Materials and Operating Temperatures.

D. Insulation Shield: Buffer material placed between the pipe support system and the insulation to prevent the insulation material from crushing.

E. Jacket: Protective covering over the pipe insulation; may be factory applied such as “all service jacket” or field applied to provide additional protection; of such materials as canvas, PVC, aluminum or stainless steel.

F. Piping Insulation: Thermal insulation applied to prevent heat transmission to or from a piping system.

G. Vapor Barrier Jacket: Insulation jacket material that impedes the transmission of water vapor.

H. Freezing Climate: Where outdoor design temperature is less than 33^{o} F, as stated in ASHRAE fundamentals under 99% column for winter design conditions.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:

1. American Society for Testing and Materials (ASTM): Manufacture and test insulation in accordance with the ASTM Standards, including:

a. B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plat.

b. C165 - Recommended Practice for Measuring Compressive Properties of Thermal Insulation.

c. C167 - Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.

d. C177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission.

e. Properties by Means of the Guarded-Hot-Plate Apparatus.

f. C195 - Specification for Mineral Fiber Thermal Insulating Cement.

g. C196 - Specification for Expanded or Exfoliated Vermiculite Thermal Insulating Cement.

h. C302 - Test Method for Density of Preformed Pipe-Covering-Type Thermal Insulation.

i. C303 - Test Method for Density of Preformed Block-Type Thermal Insulation.

j. C305 - Test for Thermal Conductivity of Pipe Insulation.

k. C356 - Test for Linear Shrinkage of Preformed High-Temperature Thermal Insulation.

l. C411 - Test for Hot-Surface Performance of High Temperature Thermal Insulation.

m. C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

n. C449 - Specification of Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

o. C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

p. C533 - Specification for Calcium Silicate Block and Pipe Thermal Insulation.

q. C534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

r. C547 - Specification for Mineral Fiber Preformed Pipe Insulation.

s. C552 - Specification for Cellular Glass Block and Pipe Thermal Insulation.

t. C553 - Specification for Mineral Fiber Blanket-Type Pipe Insulation (Industrial Type).

u. C592 - Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered).

v. C612 - Specification for Mineral Fiber Block and Board Thermal Insulation.

w. C916 - Standard Specification for Adhesives for Duct Thermal Insulation.

x. C921 - Practice for Determining Properties of Jacketing Materials for Thermal Insulation.

y. C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.

z. C1071 - Standard Specification for Thermal and Acoustical Insulation.

aa. C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.

bb. E84 - Test Method for Surface Burning Characteristics of Building Materials.

cc. E119 - Test for Fire Resistance.

dd. G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

ee. G22 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Bacteria.

2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Provide and install pipe and duct insulation in accordance with the following ASHRAE Standard:

a. 90 Energy Conservation in New Building Design.

3. National Fire Protection Association (NFPA): Manufacture insulation in accordance with the following NFPA standards:

a. 255 Test Methods, Surface Burning Characteristics of Building Materials.

B. Do not provide materials with flame proofing treatments subject to deterioration due to the effects of moisture or high humidity.

C. Products Containing Prohibited Chemicals:

1. Products containing the following prohibited chemicals for use as flame retardants or for other purposes will not be acceptable when present in quantities greater than 0.1% by mass:

a. Pentabrominated diphenyl ether (CAS#32534-81-9)

b. Octabrominated diphenyl ether (CAS#32536-52-0)

c. Decabrominated diphenyl ether (CAS#1163-19-50

D. Flame/Smoke Rating: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing; or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

E. Corrosiveness: Provide insulation such that when tested in accordance with the following test, the steel plate in contact with the insulation shows no greater corrosion than sterile cotton in contact with a steel plate for comparison.

1. Test Specimen: Two specimens shall be used, each measuring 1” by 4” by approximately ½” thick.

2. Apparatus: Provide a humidity test chamber in which two polished-steel test plates, 1” wide, 4” long and 0.020” thick, shall be placed. Plates shall be clear finish, cold-rolled strip steel, American quality, quarter hard, temper No. 3, weighing 0.85 lb/sq. ft.

3. Procedure: The steel test plates shall be rinsed with cp benzol until their surfaces are free from oil and grease and allowed to dry. One piece of cold-rolled steel shall be placed between the two insulation specimens and secured with tape or twine. The test specimen and uncovered plate shall be suspended vertically in an atmosphere having a relative humidity of 95% (plus or minus 3%), and a temperature of 120°F (plus or minus 3°F), for 96 hours, and then be examined for corrosion.

F. Insulation thickness shall be the greater standard of that specified here or the State energy conservation requirements.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation. Also furnish necessary test data certified by an independent testing laboratory. Submit samples.

B. Provide a statement with the submittal indicating that no product submitted contains an amount equal to or greater than 0.10% by mass of the following chemicals:

1. Pentabrominated diphenyl ether (CAS#32534-81-9)

2. Octabrominated diphenyl ether (CAS#32536-52-0)

3. Decabrominated diphenyl ether (CAS#1163-19-50

C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product in maintenance manual.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coating to the site in containers with manufacturer's stamp or label affixed showing fire hazard indexes of products.

B. Store and protect insulation against dirt, water, chemical, and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design is insulation provided by Knauf, Johns Manville, Owens-Corning, , Armstrong, Pittsburgh-Corning, Trymer, IIG, Certainteed, Halstead, Rubatex, 3M FireMaster, Pabco, Reflectix, or approved equal. Manufacturer and insulation types listed below indicate a minimum acceptable level of quality required for each classification.

2.2 DUCTWORK INSULATIONS

A. Type DW-A Flexible Glass Mineral Wool Blanket bonded with a bio-based thermosetting resin. Comply with ASTM C 553, Type I, II, and III and ASTM C 1290, Type I. UL/ULC Classified per UL 723 for FSK; FHC 25/50 per ASTM E 84. UL GREENGUARD, UL Environment, or Scientific Certification Systems (SCS) validated as formaldehyde free, DecaBDP free. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Knauf Insulation; Atmosphere Duct Wrap with ECOSE Technology, Owens Corning SOFTR Duct Wrap FRK, or equal
2. Application: Insulation wrap for ductwork, or other HVAC systems.

3. 'K' Value: ASTM C553-92, 0.27 Btu•in./(hr•ft²•ºF) at 75°F installed full thickness.
4. Density: 1.0 lb/cu ft.
5. Vapor Barrier Jacket: FSK (Foil-Scrim-Kraft) aluminum foil faced reinforced with glass mineral wool yarn and laminated to fire-resistant kraft.
6. Installation: See Part 3 below.

B. Type DW-B Elastomeric Foam Flexible Insulation: Armacell Industries model AP Armaflex and AP Coilflex, or equal:

1. Greenguard certified, low VOC.
2. Elastomeric foam insulation with acrylic polymer airstream coating.
3. K' Value: ASTM C518, 0.25 Btu•in./(hr•ft²•ºF) at 75°F.
4. R' value per inch thickness: ASTM C518, 4.0 (hr•ft²•ºF) / Btu at 75°F.
5. Density: ASTM D 1622, 3.0-6.0 lb/ft3.
6. Water vapor sorbtion: ASTM C 1104, less than 2% by weight.
7. Fungal and bacteria resistance: ASTM G 21/22, no growth.
8. Noise Reduction Coefficient: ASTM C 423, 0.49 or higher based on "Type A mounting."
9. Maximum Velocity on Mat or Coated Air Side: 5,000 ft/min.
10. Maximum operating temperature: 250 degrees F.
11. Flame spread index: ASTM E84, less than 25
12. Smoke developed index: ASTM E84, less than 50
13. Adhesive: UL listed waterproof type compliant with ASTM C916.

2.3 ACOUSTIC DUCT LINER:

A. Type ADL-B Flexible Elastomeric Foam Duct Liner:

1. Elastomeric foam insulation with acrylic polymer airstream coating.
2. K' Value: ASTM C518, 0.25 Btu•in./(hr•ft²•ºF) at 75°F.
3. R' value per inch thickness: ASTM C518, 4.0 (hr•ft²•ºF) / Btu at 75°F.
4. Density: ASTM D 1622, 3.0-6.0 lb/ft3.
5. Water vapor sorbtion: ASTM C 1104, less than 2% by weight.
6. Fungal and bacteria resistance: ASTM G 21/22, no growth.
7. Noise Reduction Coefficient: ASTM C 423, 0.49 or higher based on "Type A mounting."
8. Maximum Velocity on Mat or Coated Air Side: 5,000 ft/min.
9. Maximum operating temperature: 250 degrees F.
10. Flame spread index: ASTM E84, less than 25
11. Smoke developed index: ASTM E84, less than 50
12. Adhesive: UL listed waterproof type compliant with ASTM C916.
13. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
14. Basis of Design Product: Armacell models AP Armaflex, AP Coilflex, AP Spiralflex or equalGreenguard certified, low VOC.

B. Type ADL-C Polyimide Foam Acoustic Duct Liner:

1. Greenguard certified, low VOC.
2. Polyimide foam insulation with acrylic polymer airstream coating.

3. K' Value: ASTM C518, 0.30 Btu•in./(hr•ft²•ºF) at 75°F.
4. R' value per inch thickness: ASTM C518, 3.3 (hr•ft²•ºF) / Btu at 75°F.
5. Density: ASTM D 3574, 0.80 lb/ft3.
6. Water vapor sorbtion: ASTM C 1104, less than 2% by weight.
7. Fungal and bacteria resistance: ASTM G 21/22, no growth.
8. Noise Reduction Coefficient: ASTM C 423, 0.70 or higher based on "Type A mounting."
9. Maximum Velocity on Mat or Coated Air Side: 5,000 ft/min.
10. Maximum operating temperature: 250 degrees F.
11. Flame spread index: ASTM E84, less than 25
12. Smoke developed index: ASTM E84, less than 50
13. Adhesive: UL listed waterproof type compliant with ASTM C916.
14. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
15. Basis of Design Product: Boyd Corporation SOLCOUSTIC duct liner, or equal

2.4 RIGID BOARD DUCTWORK AND PLENUM INSULATION:

A. Type RB – A rigid fiber glass board bonded with a thermosetting resin meeting ASTM C612 Type IA or IB with factory-applied FSK jacket. UL/ULC Classified or FHC 25/50 per ASTM E84 and GREENGUARD Certification Standard for Low-Emitting Products.

1. Application: insulation for HVAC plenums and ductwork.
2. 'K' Value: ASTM C1071, 0.23 Btu•in./(hr•ft²•ºF) at 75°F.
3. Density: 3.0 lb/cu ft.
4. Vapor Barrier Jacket: ASJ (All Service Jacket) or FSK (Foil-Scrim-Kraft) aluminum foil faced reinforced with glass mineral wool yarn and laminated to fire-resistant kraft paper.
5. Installation: See Part 3 below.
6. Basis-of-Design Product: Subject to compliance with requirements, provide Insulation; Insulation Board by Knauf ECOSE, CertainTeed Corp., Johns Manville 800 Series Spin-Glas, Manson Insulation Inc., or Owens Corning Tpe 703 Insulation Board.

2.5 FIRE-RATED INSULATION SYSTEMS

A. Type FRI-A. Hydrous Calcium Silicate: Johns Manville Industrial Insulation Group Thermo-12/Gold ASTM C533; Rigid Molded Block Insulation; Asbestos-Free Coded Throughout Material Thickness and Maintained Throughout Temperature Range:

1. "K" Value: 0.397 Btu•in./(hr•ft²•ºF) at 300ºF.
2. Maximum Service Temperature: 1,200°F.
3. Compressive Strength (block): Minimum of 100 psi to produce 5% compression at 1½" thickness.
4. Tie Bands: Secure blocks in places with staggered joints using 3/8" or 1/2" stainless steel bands on 12" centers.

B. Type FRI-B. Insulation for Type I, commercial, kitchen hood exhaust ductwork. High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a **2**-hour fire rating.

1. Acceptable products include CertainTeed Corp.; FlameChek, Nelson Firestop Products; Nelson FSB Flameshield Blanket, Thermal Ceramics; FireMaster Duct Wrap, 3M; Fire Barrier Wrap 15A, or Unifrax Corporation; FyreWrap.

C. Type FRI-C. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700°F (927°C). Comply with ASTM C656, Type II, Grade 6. UL tested and certified to provide a 2-hour fire rating.

1. Acceptable Products include, Johns Manville Industrial Insulation Group Super Firetemp M or equal.

D. Type FRI-D. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 2-hour fire rating.

1. Acceptable Products include, CertainTeed Corp.; FlameChek, Johns Manville; Firetemp Wrap, Nelson Firestop Products; Nelson FSB Flameshield Blanket, Thermal Ceramics; FireMaster Duct Wrap, 3M; Fire Barrier Wrap 15A, Unifrax Corporation; FyreWrap, or Vesuvius; PYROSCAT FP FASTR Duct Wrap.

2.6 FIELD APPLIED DUCTWORK INSULATION JACKETS

A. Field Applied Jackets (For Exterior Applications):

1. Longitudinal seams shall not be located on top of ducts when exposed to outdoor environment.
2. Stainless Steel Jacket: Type 304 stainless steel, 0.010” minimum (smooth/corrugated) finish.
3. Aluminum Jacket: 0.016” aluminum with factory applied moisture barrier positioned such that the longitudinal overlap provides a watershed.
4. PVC Jacket: Johns Manville Zeston 300 30 mil thick white only.
5. Circumferential joints shall be wide enough to provide weather-proofing jacket.
6. Secure jacket with 3/8" or 1/2" stainless steel bands on 12” centers for round ductwork and objects.
7. Secure to rectangular sheet metal with sheet metal screws. Seal screw penetrations with silicone caulk.

B. Field Applied Jackets (For Interior Applications):

1. All longitudinal seams shall be located on bottom of ductwork
2. PVC Plastic: Johns Manville Zeston 2000. One piece molded type fitting covers and jacketing material, gloss white. Connect with tacks and pressure sensitive color matching vinyl tape.

2.7 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds if possible. Products shall be certified UL GREENGUARD Gold or Indoor Advantage Gold if possible.

C. UL Environment or GREENGUARD Certification shall validate that each product is formaldehyde free.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.8 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following: Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90, Vimasco Corporation; 749, or equal.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30, Eagle Bridges - Marathon Industries; 501, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35, Mon-Eco Industries, Inc.; 55-10, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel, Eagle Bridges - Marathon Industries; 570, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10, Eagle Bridges - Marathon Industries; 550, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50, Mon-Eco Industries, Inc.; 55-50, Vimasco Corporation; WC-1/WC-5, or equal.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.9 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36, Vimasco Corporation; 713 and 714, or equal.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
5. Color: White.

2.10 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405, Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44, Mon-Eco Industries, Inc.; 44-05, or equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: Aluminum.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealants 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."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following: Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76, or equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: White.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealants 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."

2.11 PIPE INSULATIONS

A. Flexible Elastomeric Closed Cell Thermal Insulation: Armacel, Rubatex k-flex ECO, closed-cell, halogen free, elastomeric insulation. Comply with ASTM-C177, ASTM E 84 and UL 181.

1. 'K' Value: 0.27 at 75°F.

2. Density: 3.0 to 6.0 lbs./cu.ft.

3. Maximum Service Temperature: 260°F.

4. Seal all seams and joints with contact adhesive.

B. Field Applied Jackets (For Interior Applications):

1. All longitudinal seams shall be located on bottom of pipes.

2. PVC Plastic: Johns Manville Zeston 2000. One piece molded type fitting covers and jacketing material, gloss white. Connect with tacks and pressure sensitive color matching vinyl tape.

3. Canvas Jacket: UL listed fabric, 6 oz/sq. yd. plain weave cotton, treated with dilute fire retardant lagging adhesive.

4. Aluminum Jacket: 0.016" thick sheet, [smooth/embossed] finish, with longitudinal slip joints and 2" laps, die shaped fitting covers with factory attached protective liner.

5. Secure aluminum jackets with 3/8" or ½" stainless steel bands on 12" centers.

C. Field Applied Jackets (For Exterior Applications):

1. All longitudinal seams, on horizontal pipe runs, shall be installed on the bottom of pipes.

2. Aluminum Jacket: 0.016" (minimum) thick sheet, [smooth/embossed] finish, with longitudinal slip joints and 2" laps, die shaped fitting covers with factory attached protective liner.

3. Stainless Steel Jacket: Type 304 stainless steel, 0.010" minimum (smooth/corrugated) finish.

4. Secure stainless steel or aluminum jackets with ⅜" or ½" stainless steel bands on 12" centers.

5. Manufacturers: Pabco, Childers, RPR, or approved equal.

D. Removable Covers:

1. Provide removable covers on pumps, valves, air separators, vents, fittings, flanges, strainers, traps, etc., where periodic maintenance or removal of insulation may is required.

2. Use of premolded fittings with PVC covers is acceptable.

3. Use of lace-on type insulating blankets is acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that piping and ductwork has been tested for leakage in accordance with specifications before applying insulation materials. All piping and ductwork shall be inspected by Owner's Representative prior to installation of insulation. Any insulation applied prior to inspection shall be removed and new insulation applied at no additional cost to Owner. Notify Owner's Representative five (5) working days prior to insulation installation.

B. Verify that all surfaces are clean, dry and free of foreign material.

3.2 INSTALLATION

A. General:

1. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.

2. Remove and replace any insulation that has become wet or damaged during the construction process.

3. Continue insulation and vapor barrier at penetrations and duct supports, except where prohibited by code. Instances where this is required include:

a. Ductwork support angle or struts. To prevent crushing of low density insulation, provide separator or high density insulation at point of support. Vapor barrier to continue unbroken at point of support.

B. Ductwork –Insulation on the Duct Exterior:

1. Provide insulated ductwork conveying air below ambient temperature (below room temperature) with vapor retardant jacket. Seal all vapor retardant jacket seams and penetrations with UL listed tapes or vapor retardant adhesive.

2. Provide insulated ductwork conveying air above ambient temperature (above room temperature) with or without vapor retardant jacket. Where service access is required, bevel and seal ends of insulation.

3. All exposed exterior metallic ductwork exposed or covered with cladding is to be built with a crown to shed moisture.

4. Continue insulation through walls, sleeves, hangers, and other duct penetrations except where prohibited by code.

5. The insulation shall be firmly wrapped around the ducts with all joints lapped a minimum of 2". The vapor barrier shall be sealed with FSK or metallic pressure sensitive tape. Installed thickness shall not exceed 25% compression. Secure insulation with 16 gage soft annealed black or galvanized wire spaced not more than 12" on centers for straight runs of duct and 6" on centers for elbows and fittings

6. The underside of duct work 24” or greater in width shall be secured with mechanical fasteners and speed clips spaced approximately 18” on center. The protruding ends of the fasteners shall be cut off flush after the speed clips are installed, and then, when required, sealed with the same tape as specified above.

7. For ductwork exposed in mechanical equipment rooms below 7’ or in finished spaces, finish with Johns Manville Zeston 2000 PVC jacket or aluminum or stainless steel jacket.

8. For exterior applications, provide insulation with a weather protection jacket.

C. Duct Liner:

1. Adhere insulation to sheet metal with a UL listed adhesive. Adhesive shall be applied to the sheet metal with a minimum coverage of 90%.

2. Secure insulation with mechanical liner fasteners as indicated by SMACNA or manufacturer. Pin length should be as recommended by the liner manufacturer.

3. All exposed edges of the liner must be factory or field coated. Unless factory coated, all transverse edges and longitudinal joints of the duct liner shall be coated. For systems operating at 4,000 fpm or higher, a metal nosing must be installed in all liner leading edges.

4. Repair liner surface penetrations with UL listed adhesive.

5. Duct dimensions indicated on plans are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

D. Piping Insulation:

1. Locate insulation and cover seams in least visible locations unless otherwise specified.

2. Neatly finish insulation at supports, protrusions, and interruptions.

3. Provide insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self sealing laps. Insulate complete system.

4. For insulated pipes conveying fluids above ambient temperature, secure jackets with self sealing lap or outward clinched, expanded staples. Seal ends of insulation at equipment, flanges, and unions.

5. Provide insert between support shield and piping on piping 1½" diameter or larger. Fabricate of Johns Manville Thermo-12, or other heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:

   a. 1½" to 2½" pipe size 10" long

   b. 3" to 6" pipe size 12" long

   c. 8" to 10" pipe size 16" long

   d. 12" and over 22" long

6. Use of metal saddles is acceptable as specified in Section 230500. Fill interior voids with segments of insulation matching adjoining pipe insulation.

7. Use of pipe hangers designed as an insulation coupling is acceptable in lieu of saddles and other devices. Klo-Shure coupling or equal.

8. For pipe exposed in mechanical equipment rooms or in finished spaces below 7 feet above finished floor, finish with Johns Manville Zeston 2000 PVC jacket and fitting covers, or aluminum or stainless steel jacket.

9. Where pumps, valves, strainers, etc., with insulation require periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage. Use of premolded covers or lace-on type insulation blankets is required.

10. For exterior applications:

    a. Provide weather protection jacket. Insulated pipe lengths, pumps, fittings, joints, and valves shall be covered with aluminum jacket or stainless steel jacket. Jacket seams shall be located on bottom side of horizontal piping. All lateral joints shall be caulked with a minimum 20-year silicone sealant (clear). All longitudinal joints, except those at the bottom of a horizontal pipe run, shall be caulked with a minimum 20-year silicone sealant (clear).

    b. Apply weather-resistant protective finish such as WB Armaflex to flexible elastomeric insulation. Insulation seams shall be located on the bottom side of horizontal piping. All lateral and longitudinal joints to be sealed with low V.O.C., UV inhibitive adhesive, such as Armaflex 520 BLV adhesive.

11. For underground installations, install per manufacturer's written instructions and recommendations.

12. When maintenance or service access for equipment will result in foot traffic over floor mounted insulated piping the contractor is to fabricate a permanent removable walkway to prevent damage to the piping and insulation.

E. Equipment Insulation:

1. See Piping Insulation above for additional requirements.

2. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands, per manufacturer's recommendations.

3. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retardant cement.

4. Provide insulated dual temperature equipment or cold equipment containing fluids below ambient temperature with vapor retardant jackets.

5. For insulated equipment containing fluids above ambient temperature, provide jacket with or without vapor barrier.

6. Cover insulation with metal mesh and finish with heavy coat of insulating cement, mastic, or aluminum jacket as indicated in the drawings.

7. For equipment in mechanical equipment rooms or in finished spaces, finish with Johns Manville Zeston 2000 jacketing and fitting covers or aluminum or stainless steel jacketing.

8. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

9. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage. Use of lace-on type insulation blankets is acceptable.

3.3 DUCTWORK INSULATION SCHEDULE

A. All insulation thicknesses shall meet or exceed state energy code and mechanical code requirements as noted below. Minimum thermal resistance in range of 4.2 to 4.6 per inch of thickness. Insulation thicknesses are based on fiberglass insulation and may be adjusted for equivalent insulation values for materials with superior "K" factors.

B. All air distribution system ducts and plenums, but not limited to, building cavities, mechanical closets, air handler boxes, and support platforms uses as ducts or plenums, shall be installed, sealed , and insulated to meet the requirements of the code. Portions of supply-air and return-air ducts conveying heated or cooled air located in one or more of the following spaces shall be insulated to a minimum level of R-8.

1. In a space between the roof and an insulated ceiling.

2. In a space directly under a roof with fixed vents or opening to the outside or unconditioned spaces

3. In an unconditioned crawlspace.

4. In other unconditioned spaces.

C. Flexible Duct Wrap:

	THICKNESS (inches)	FINISH	REMARKS
Supply ducts within building envelope	1-1/2	FSK	
Return ducts within building envelope	1-1/2	FSK	
Exterior/Outside supply and return ductwork sandwiched in double wall sheet metal	2-1/2	FSK	* or a thickness resulting in compressed R value=8
Supply and return ductwork located as described in 3.3.B above.	2		
Exhaust ducts within 10 ft. of exterior openings	2	FSK	
Exhaust ducts and ventilation equipment casing exposed to outdoor air	2	FSK	
Exhaust ducts within 10 ft. of exterior openings	2	FSK	Type DW-A,B

D. Thicknesses in the above table shall have insulation values as follows: 1 1/2 " = R-6, 2" = R-8.0, 3" = R-12. Greater thicknesses are permitted to achieve identical values if space constraints allow.

E. Rigid and Plenum Insulation

	THICKNESS (inches)	FINISH	REMARKS
Outside air intake ducts	1-1/2	FSK	
Interior Plenums	1-1/2	FSK	
Exterior Plenums	2	FSK	
Supply, return and relief ducts in mechanical rooms and parking garages	2	FSK	
Exterior ductwork sandwiched in double wall sheet metal	2	FSK	

F. Duct Liner:

	THICKNESS (inches)	FINISH	REMARKS
Where indicated	1" unless otherwise noted on plans	Linacoustic	
Exterior ductwork in sandwiched in double wall sheet metal	2	Linacoustic	
Within 20' of Air Handling Unit in supply and return ducts	2	Solcoustic	
Within 15' of Exhaust fans	2	Solcoustic	

G. Duct Liner (round):

	THICKNESS (inches)	FINISH	REMARKS
Where indicated	1	Spiracoustic	

3.4 PIPING INSULATION SCHEDULE

A. All insulation thicknesses shall meet or exceed state energy code requirements as noted below. Increase thickness 1/2" if exposed to exterior ambient air. Minimum thermal resistance shall comply with building code minimum ranges and may exceed those minimum levels. Insulation thicknesses may be adjusted for equivalent insulation values for materials with superior "K" factors.

B. Elastomeric Foam (Closed Cell):

	PIPE SIZE (inches)	THICKNESS (inches)	REMARKS
Chilled condensate drain pipes	All Sizes	1/2	
Refrigerant Piping	All Sizes	1 1/2	

END OF SECTION

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 COMMISSIONING AUTHORITY

A. The commissioning authority (CxA) has been contracted directly with the owner for this project. The CxA has overall responsibility for planning and coordinating the commissioning process. However, commissioning involves all parties involved with the design and construction process, including the mechanical (Division 22 and 23) contractor, and all specialty subcontractors within Division 23, such as sheet metal, piping, refrigeration, water treatment, TAB and controls, plus major equipment suppliers as required.

1.2 CONTRACTOR RESPONSIBILITY

A. The mechanical (Division 23) contractor's responsibilities are defined in Section 01 9113, "Commissioning Requirements" of the specifications. These responsibilities apply to all specialty subcontractors and major equipment suppliers within Division 23. Each subcontractor and supplier shall review Section 01 9113, and their bids shall include for carrying out the work described, as it applies to each section within the Division 23 specifications, individually and collectively.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include but not necessarily be limited to the following:

1. Integrate with

2. Submit shop drawings of the entire control system components fully coordinated with major equipment suppliers' requirements. Provide proposed programming logic sequences of control functions on each system.

3. System shall control and monitor all div 23 related equipment. Where manufacturer controllers are provided due to internal safeties & operation full integration with this system is required.

4. Installation of control components other than valves, dampers and sensing wells as required for a complete and workable system.

5. This Contractor shall furnish, install and coordinate the interlock and control wiring as specified and/or required for a complete and workable control system.

6. Controls dampers are specified and furnished in Section 233113 of these specifications. Provide damper actuators, wiring and conduit as required to operate all dampers as shown.

7. Upon completion of the installation, data entry and programming, provide complete validation and adjustment of specified control system through period of testing and Owner’s acceptance. The control contractor shall perform a point-to-point check out of all newly installed points to verify point existence, proper end to end connection and correct SI units with the Owners Representative.

8. The entire program and sequence of operation with the final points list shall be verified by the Control Contractor, the Owners Representative, and signed by both parties. A copy of the final program, sequence of operation, and points list shall be submitted to the Engineer for approval and inclusion with the operation and maintenance manuals.

9. Owner training on operation of the control system.

10. One-year warranty on workmanship and materials.

11. Interlocking of electrical systems and motors as shown on Drawings, except where specifically shown on electrical drawings.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Sources of 120-volt electrical power as indicated on the Electrical drawings and specifications for control system components furnished by this section. The controls contractor shall be responsible for all additional electrical distribution from these connection points to the control panels and other controls devices.

B. Provide certificates of calibration for all sensors required for DDC control and DDC monitoring including temperature and pressure.

1.4 QUALITY ASSURANCE

A. Manufacturers are subject to compliance with requirements contained herein and on the Drawings. Control systems shall be provided by one of the following manufacturers, no other manufacturers will be considered for this work:

1. Siemens (Apogee)

a. Campus system integration required.

B. Electrical Standards: Provide electrical products that have been tested, listed, and labeled by Underwriter Laboratories (UL) and comply with NEMA standards.

1.5 SUBMITTALS

A. Prior to construction submit for approval the following materials:

1. Wiring diagrams.

2. Sequence of operation, control logic and control points list.

3. Controls service contract.

4. Operations and maintenance manuals.

5. Temperature sensors, with bypass buttons where shown.

6. Pressure sensors.

7. Duct smoke detectors.

8. Actuators.

9. Control valves (Note that service valves are specified in Section 230500 of these documents)

10. Dampers (Note that dampers are specified in Section 233113 of these documents)

11. Miscellaneous Devices.

12. Airflow measuring elements.

13. Control panels and controllers.

14. Other components such as relays, solenoid valves, restrictors, etc., complete material submittal.

15. Parts list for each system control.

1.6 LAYOUT DRAWINGS

A. Prior to the start of installation, submit to the Owner's Representative for approval layout drawings coordinated with all building systems, and lists of materials, fixtures, and equipment to be incorporated in the work. The layout drawings shall consist of plans and diagrams to show clearly the locations and size of major items of equipment and controls. The general arrangement of the systems to be installed, coordination with other work, and all requirements for installation shall be met.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products against dirt, water, chemical, and mechanical damage. Do not install damaged components; remove from project site.

PART 2 - PRODUCTS

2.1 GENERAL

A. All components used shall be serviceable, repairable, and replaceable by qualified temperature control technicians using non-proprietary parts, tools, and instruments.

2.2 IDENTIFICATION

A. All control devices shall have identification means attached to the front or most visible surface. Room thermostat having no special purpose other than to control local temperature shall not be identified.

B. Small Devices: Milled laminate plates secured with epoxy cement.

2.3 FIELD DEVICES

A. Provide instrumentation as required for monitoring, control or optimization functions. All devices and equipment shall be approved for installation in the City of Eugene.

B. Room Temperature Sensors

1. Blank face standard room sensor except where plans or specifications call for override buttons, setpoint adjustment, or displays.

Temperature monitoring range	+20/120°F (-13° to 49°C)
Output signal	Changing resistance
Accuracy at Calibration point	±0.5°F (+/- 0.3°C)
Set Point and Display Range	55° to 95° F (13° to 35°C)

2. Liquid immersion temperature:

Temperature monitoring range	+30/250°F (-1°/121°C)
Output signal	Changing resistance
Accuracy at Calibration point	±0.5°F (+/-0.3°C)

3. Duct (single point) temperature:

Temperature monitoring range	+20/120°F (-7°/49°C)
Output signal	Changing resistance
Accuracy at Calibration point	±0.5°F (+/-0.3°C)

4. Duct Average temperature:

Temperature monitoring range	+20° +120°F (-7°/+49°C)
Output signal	4 – 20 mA DC
Accuracy at Calibration point	+0.5°F (+0.3°C)
Sensor Probe Length	25’ L (7.3m)

5. Outside air temperature:

Temperature monitoring range	-58°±122°F (-50°C to +50°C)
Output signal	4 – 20 mA DC
Accuracy at Calibration point	±0.5°F (+/-0.3°C)

6. Liquid Differential Pressure Transmitter

Ranges	0-5/30 inches H2O 0-25/150 inches H2O 0-127/750 inches H2O
Output	4 – 20 mA DC
Calibration Adjustments	Zero and span
Accuracy	+-0.2% of span
Linearity	+-0.1% of span
Hysteresis	+-0.05% of span

7. Differential pressure:

   a. Unit for fluid flow proof shall be Penn P74.

Range	8 to 70 psi
Differential	3 psi
Maximum differential pressure	200 psi
Maximum pressure	325 psi

   b. Unit for air flow shall be Siemens Building Technologies SW141.

Set point ranges:	0.5” WG to 1.0” WG 1.0” WG to 12.0” WG	(124.4 to 248.8 Pa) (248.8 to 497.6 Pa)

8. Static pressure sensor:

Range	0 to .5” WG (0 to 124.4 Pa) 0 to 1” WG (0 to 248.8 Pa) 0 to 2” WG (0 to 497.7 Pa) 0 to 5” WG (0 to 1.2 kPa) 0 to 10” WG (0 to 2.5 kPa)
Output signal	4 – 20 mA VDC
Combined static error	0.5% full range
Operating Temperature	-40° to 175°F (-40°C to 70.5°C)

9. Air Pressure Sensor:

Range	0 to 0.1 in. water (0 to 24.9 Pa) 0 to 0.25 in. water (0 to 63.2 Pa) 0 to 0.5 in. water (0 to 124.5 Pa) 0 to 1.0 in. water (0 to 249 Pa) 0 to 2.0 in. water (90 to 498 Pa) 0 to 5.0 in. water (0 to 1.25 kPa) 0 to 10.0 in. water (0 to 2.49 kPa)
Output signal	4 to 20 mA
Accuracy	+1.0% of full scale

10. Humidity Sensors:

Range	0 to 100% RH
Sensing Element	Bulk Polymer
Output Signal	4 – 20 mA DC
Accuracy	At 77°F (25°C) $\pm$ 2% RH

11. Insertion Flow Meters (Equal to Onicon Series F-1200)

Sensing Method	Impedance Sensing
Accuracy	± 2% of Actual Reading
Maximum Operating Pressure	400 PSI
Output Signal	4 – 20 mA
Bi-directional	Where required

12. Pressure to Current Transducer

Range	3 to 15 psig (21 to 103 kPa) or 3 to 30 psig (21 to 207 kPa)
Output signal	4 – 20 mA
Accuracy	± 1% of full scale (± 0.3 psig)

13. Control Valves (all control valves shall have electric actuators).

Electric Control	
Rangeability	40:1
Flow Characteristics	Modified. Equal percentage
Control Action	Normal open or closed as selected
Medium	Steam, water, glycol
Body Type	Screwed ends 2" and smaller, flanged Valves 2 ½ and larger
Body Material	Bronze for cast bodies Brass acceptable for forged valves
Body Trim	Bronze for cast bodies Brass acceptable for forged valves
Stem	Stainless steel for globe valve Brass acceptable for ball valves
Actuator	0-10 VDC, 4-20 MA or 2 position 24 VAC/120VAC

a. All automatic temperature control valves in water lines shall be provided with characterized throttling plugs or ball and shall be sized for minimum 25% of the system pressure drop or 5 psi, whichever is less.

b. Positive positioning relays shall be provided on pneumatic control when required to provide sufficient power for sequencing.

c. Two position valves shall be line size.

d. Control valves shall be two-way or three-way pattern as shown, constructed for tight shut-off and shall operate satisfactorily against system pressures and differentials. Valves shall be constructed to satisfactorily operate and close against a maximum pump head pressure plus 50%. Valves with sizes up to and including 2" shall be "screwed"; 2-½" and larger valves shall be "flanged"

configuration. Control valves shall be sized for maximum pressure drop of 5.0 psig at rated flow (except as noted).

e. Valve design shall produce a true equal percentage flow characteristic. Globe valve or characterized ball valves are acceptable in the ½" to 2" range size.

f. See Section 232113 for additional valve specifications including acceptable manufacturers or packagers of valve/actuator assemblies.

g. Valve actuators shall be rated for at least 125% of the motive power necessary to operate the valves over their full range of operation against the total and differential pressures shown, including torque required to seat or unseat resilient seated butterfly valves.

14. Actuators

a. Actuators shall be Underwriters Laboratories Listed under Standard 873 or Canadian Standards association Class 4813 02 and have NEMA type 2 housings -- water and moisture resistant. Spring return actuators mounted near outdoor air streams shall have a semi-permeable membrane to remove moisture from inside actuator.

b. Actuators shall be applied according to the manufacturer's application instructions. See execution for additional requirements.

c. Each actuator shall be factory tested before shipment at 110% of guaranteed minimum torque.

d. Damper actuators shall be rated and tested for at least 125% of the maximum motive power necessary to operate against the pressure shown.

e. Overload Protection: Actuators shall provide protection against actuator burnout using an internal current limited circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation or use of magnetic clutches are not acceptable.

f. Actuators shall be properly sized to provide sufficient torque to position the damper or valve throughout its operating range.

g. For power failure and safety applications a mechanical spring return mechanism shall be used. Capacitors or other non-mechanical forms of fail-safe are not acceptable except a "central emergency backup power source".

h. Actuators shall be direct coupled (over the shaft) enabling them to be mounted directly to the damper shaft without the need for connecting linkage. The clamp holding the damper shaft shall use a V-bolt and toothed V-clamp causing a cold-weld effect for positive griping. Single bolt or setscrew type fasteners are not acceptable.

i. Actuators shall be capable of being mechanically and electrically paralleled to increase torque where required.

j. Spring return actuators should be capable of mounting directly onto a jackshaft up to 1.05" diameter.

k. Provide spring return actuators for AHU economizer dampers.

l. Provide spring return and end switches on all 100% OSA dampers.

C. Ventilation Damper actuators

1. When the actuator is at either the full open or full closed position, continual pulsing of actuator against end stops (end stop dithering) shall not occur. Actuator shall be constructed to de-energize or stall against the end stop.

2.4 MISCELLANEOUS DEVICES

A. Thermostats

1. Room thermostats shall be of the gradual acting type with adjustable sensitivity.

2. They shall have a bi-metal sensing element capable of responding to a temperature change of one-tenth of one degree. (Provide all thermostats with limit stops to limit adjustments as required.)

3. Thermostats shall be arranged for either horizontal or vertical mounting.

4. In the vertical position thermostat shall fit on a mullion of movable partitions without overlap.

5. Mount the thermostat covers with tamper-proof socket head screws.

B. Freezestats:

1. Install freezestats as indicated on the plans and provide protection for every square foot of coil surface area with one linear foot of element per square foot of coil.

a. Upon detection of low temperature, the freezestats shall stop the associated supply fans and return the automatic dampers to their normal position. Provide manual reset.

C. Firestats:

1. Provide manual reset, fixed temperature line voltage type with a bi-metal actuated switch.

2. Switch shall have adequate rating for required load.

D. Current Sensing Relay:

1. Provide solid-state, adjustable, current operated relay. Provide a relay which changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit.

2. Adjust the relay switch point so that the relay responds to motor operation under load as an "on" state and so that the relay responds to an unloaded running motor as an "off" state. A motor with a broken belt is considered an unloaded motor.

3. Provide for status device for all fans and pumps.

E. Carbon Dioxide Sensors

1. General: Sensor for IAQ demand control.

2. Sensor: Non-dispersive infrared sensing technology. Sensor chamber shall be manufacturer with a non-corrosive material (i.e. gold plating) that does not affect sampling.

3. Detection range: 0 to 3000 ppm. +/- 5% and +/- 50 ppm. Annual drift 20 ppm nominal

4. Analog Output: 4-20 mA, 0-10 Vdc.

F. Airflow Measuring Arrays

1. Fan flow measurement: Supply and return fan inlets shall be provided with airflow measuring devices. This device shall not obstruct the inlet cone to the fan, nor add any pressure losses or sound level increases to the fan performance. The unit shall be AMCA lab tested for accuracy of 3%±.

2. Outside Air Measurement: Provide a minimum outside airflow measuring station in a straight duct section upstream from the minimum outside air dampers and interfacing control for providing an electronic signal for use by the control contractor in controlling a minimum outside airflow. On outdoor mounted units, outside airflow measurement station is to be factory mounted on the intake side of the outside air intake.

3. Control Damper flow measurement: Where indicated on schedules, control dampers shall be provided with airflow measuring devices in a straight duct section upstream from the damper and interfacing control for providing electronic signal for use by the control contractor in controlling airflow.

4. Sensor Performance:

a. Fan Installation:

1) Installed airflow accuracy: +/- 3% to 10% of reading with +/- 0.25% repeatability.

2) Sensor probe performance: +/- 2% of reading, 0-5000 fpm, 0.15°F temperature accuracy +/-.

b. Outside Air/duct Installation:

1) Installed airflow accuracy: +/- 2% of reading with +/- 0.25% repeatability.

2) Sensor probe performance: +/- 2% of reading, 0-5000 fpm, 0.15°F temperature accuracy +/-.

c. Control Damper/duct Installation:

1) Installed airflow accuracy: +/- 2% of reading with +/- 0.25% repeatability.

2) Sensor probe performance: +/- 2% of reading, 0-5000 fpm, 0.15°F temperature accuracy +/-.

5. Transmitter:

a. Flow measuring array to include a transmitter for flow and temperature analog output signal for the building energy management system in either 4-20 mA or 0-10VDC. Coordinate signal output with controls installer.

b. Transmitter to include an analog airflow gauge to provide direct analog readout in cfm. Mount on the outside of the air handler if air handler is located in a mechanical room. Mount in a NEMA 3R control cabinet if located outside.

c. Device to provide switch selectable Modbus or Johnson N2 outputs.

6. Airflow measuring station to be by Ebtron

2.5 PRESSURE INDEPENDENT TEMPERATURE CONTROL VALVES (COIL CONTROL VALVES)

A. Modulating control valves shall be pressure independent characterized two-way actuated flow control valves. The flow rate through the valve shall not vary more than + or - 5% due to system pressure fluctuations across the valve in the selected operating range.

B. The range-ability of the valve shall be 90:1 (minimum).

C. The valve bodies shall be of cast brass and rated for 200 PSI working pressure (minimum). All internal parts shall be stainless steel, teflon, brass, or bronze. The valves shall be serviceable without removing them from the piping system. Valve flow characteristics shall be able to be changed without removing the valve from the piping system.

D. Balancing valves shall not be required where these control valves are installed. Flow performance curves shall be provided with each valve

E. The actuator shall modulate the control valve from 0 to 100% design flow. The actuator shall be directly coupled to the valve at the factory.

F. Pressure/temperature ports (Pete's Plugs) shall be installed at the factory in each valve larger than 1". Two ports shall be used to measure inlet and outlet pressure to the valve.

G. Manufacturer: Belimo PICCV or approved equal by Flow Control Industries, Inc. or Griswold. Valves shall be provided by controls provider and installed by piping installer.

2.6 WIRE AND CABLE, TRANSFORMERS AND TERMINAL BLOCKS

A. Wire and Cable General: Wire and cable jacket material shall be flame retardant PVC, or fluoraopolymer as required for the application per NFPA 70. Multiconductor cable shall have an outer jacket. Wire and cable not indicated as GFE shall be provided.

B. Control Wiring

1. Digital Functions: Control wiring for digital functions shall be 18 AWG minimum with 600-volt insulation.

2. Analog Functions: Control wiring for analog functions shall be 18 AWG minimum with 600-volt insulation, twisted and each pair shielded, 2, 3, or 4 wire to match analog function hardware.

C. Sensor Wiring: Sensor wiring shall be 20 AWG minimum twisted and shielded, 2, 3, or 4 wire to match analog function hardware.

D. Terminal Blocks: Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

E. Transformer: Step-down transformer shall be utilized where control equipment operates at lower than line circuit voltage. Transformer, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformer shall be sized so that the connected load is 80 % of the rated capacity or less. Transformer shall conform to UL 508 and NEMA ST1.

F. Nonconducting Wiring Duct: UL listed nonconducting wiring duct in control panels shall have slotted sides, snap-on duct covers, fittings for connecting ducts, mounting clips for securing ducts, and wire-retaining clips. Wire shall be sequentially labeled on both ends for identification with point address.

2.7 DDC CONTROLS

A. General: This specification defines the minimum equipment and performance requirements for a Direct Digital Control (DDC) building control system

B. Scope of Work: The Control Contractor shall furnish and install all equipment, accessories, wiring and instrument piping required for a complete and functioning system.

1. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and shall not be custom designed especially for this project. All components shall have been thoroughly tested and proven in actual use.

2. The building control system shall possess a fully modular architecture, permitting expansion through the addition of more stand-alone control units, temperature sensors, pressure sensors, actuators, and/or operator terminals.

3. Supervision and checkout of the system shall be by local branch engineers and technicians directly employed by the Control Contractor.

C. Warranty: The building control system, including all hardware and software components shall be warranted for a period of one year following the date of beneficial use. Any manufacturing defects arising during this period shall be corrected without cost to the owner.

D. Building Control System: The building control system specified herein shall be a Direct Digital Control system which can, without additional equipment, perform all of the automatic temperature control and energy management functions as required on the accompanying plans. Direct Digital Control shall be defined as a control technique through which the process variable is continuously monitored by a digital computer which accomplished loop control by calculating a control solution for output to a control device.

E. The system, as specified, shall independently control the building's HVAC equipment to maintain a controlled environment in an energy efficient manner. The building operator shall communicate with the system and control the sequence of operation to maintain 78 degrees Fahrenheit during the summer (user defined period) and 70 degrees Fahrenheit during the winter (user defined period).

2.8 GENERAL PRODUCT DESCRIPTION

A. The Facility Management System shall be capable of integrating multiple building functions including equipment supervision and control, alarm management, energy management, and historical data collection and archiving.

B. The facility management system shall consist of the following:

1. Standalone DDC panels

2. Standalone application specific controllers (ASCs)

3. Portable Operator's Terminals

4. Personal Computer Operator Workstations.

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, standalone DDC panels, and operator devices.

D. System architectural design eliminate dependence upon any single device for alarm reporting and control execution. Each DDC panel shall operate independently by performing its own specified control, alarm management, operator I/O, and historical data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

E. Standalone DDC panels shall be able to access any data from, or send control commands and alarm reports directly to any other DDC panel or combination of panels on the network without dependence upon a central processing device. Standalone DDC panels shall also be able to send alarm reports to multiple operator workstations without dependence upon a central processing device.

2.9 COMMUNICATIONS

A. Inherent in the system's design shall be the ability to expand or modify via an auto-dial telephone line modem connections.

B. Dial-Up Communications: Auto-dial/auto-answer communications shall be provided to allow standalone DDC panels to communicate with remote operator stations on an intermittent basis via telephone lines.

1. Dial-Up Standalone DDC Panels: Auto-Dial panels shall automatically place calls to workstations to report critical alarms, or to upload trend and historical information for archiving.

a. Standalone DDC Panels shall analyze and prioritize all alarms to minimize the initiation of calls. Non-critical alarms shall be buffered in memory and reported as a group of alarms, or until an operator manually requests an upload of all alarms.

b. The auto-dial program shall include provisions for handling busy signals, "no-answers", and incomplete data transfers. Default devices shall be called when communications cannot be established with primary devices.

C. Modem characteristics: dial-up communications shall make use of 52k baud modems and voice grade telephone lines. Each standalone DDC panel may have its own modem, or a group of standalone DDC panels may share a modem.

2.10 STAND-ALONE DDC PANELS

A. General: Standalone DDC panels shall be microprocessor based, multi-tasking, multi-user, real-time digital control processors. Each standalone DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules. A sufficient number of controllers shall be supplied to fully meet the requirements of this specification and the attached point list.

B. Memory: Each DDC panel shall have sufficient memory to support its own operating system and data bases including:

1. Control processes
2. Energy Management Applications
3. Alarm Management
4. Historical/Trend Data for all points
5. Maintenance Support Applications
6. Custom Processes
7. Operator I/O
8. Dial-Up Communications
9. Manual Override Monitoring

C. Point types: Each DDC panel shall support the following types of point inputs and outputs:

1. Digital Inputs for status/alarm contacts
2. Digital Outputs for on/off equipment control
3. Analog Inputs for temperature, pressure, humidity, flow, and position measurements
4. Analog Outputs for valve and position control, and capacity control of primary equipment
5. Pulse Inputs for pulsed contact monitoring

D. Expandability: The system shall be modular in nature, and shall permit easy expansion through the addition of software applications, workstation hardware, field controllers, sensors, and actuators.

E. The system architecture shall support 10% expansion capacity of all types of DDC panels, and all point types included in the initial installation.

F. Serial Communication Ports: Standalone DDC panels shall provide at least two RS-232C serial data communication ports for simultaneous operation of multiple operator I/O devices such as industry standard printers, laptop workstations, PC workstations, and panel mounted or portable DDC panel Operator's Terminals. Standalone DDC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or network terminals.

G. Hardware Override Switches: As indicated in the point schedule, the operator shall have the ability to manually override automatic or centrally executed commands at the DDC panel via local, point discrete, onboard hand/off/auto operator override switches for binary control points and gradual switches for analog control type points. These override switches shall be operable whether the panel is powered or not.

H. Hardware Override Monitoring: DDC panels shall monitor the status of position of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited. DDC panels shall also collect override activity information for daily and monthly reports.

I. Local Status Indicator Lamps: The DDC panel shall provide local status indication for each binary input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.

J. Integrated On-Line Diagnostics: Each DDC panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment. The DDC panel shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each DDC panel, and shall not require the connection of an operator I/O device.

K. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.

L. Powerfail Restart: In the event of the loss of normal power, there shall be an orderly shut down of all standalone DDC panels to prevent the loss of database or operating system software. Non-Volatile memory shall be incorporated for all critical controller configuration data, and battery back-up shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

1. Upon restoration of normal power, the DDC panel shall automatically resume full operation without manual intervention.

2. Should DDC panel memory be lost for any reason, the user shall have the capability of reloading the DDC panel via the local area network, via the local RS-232C port, or via telephone line dial-in.

2.11 SYSTEM SOFTWARE FEATURES

A. General

1. All necessary software to form a complete operating system as described in this specification shall be provided.

2. The software programs specified in this section shall be provided as an integral part of the DDC panel and shall not be dependent upon any higher level computer for execution.

B. Control Software Description:

1. Pre-Tested Control Algorithms: The DDC panels shall have the ability to perform the following pre-tested control algorithms:

   a. Two Position Control

   b. Proportional Control

   c. Proportional plus Integral Control

   d. Proportional, Integral, plus Derivative Control

   e. Automatic Control Loop Tuning

2. Equipment Cycling Protection: Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.

3. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

4. Powerfail Motor Restart: Upon the resumption of normal power, the DDC panel shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operation.

C. Energy Management Applications: DDC Panels shall have the ability to perform any or all of the following energy management routines:

1. Time of Day Scheduling

2. Calendar Based Scheduling

3. Holiday Scheduling

4. Temporary Schedule Overrides

5. Optimal Start

6. Optimal Stop

7. Night Setback Control

8. Enthalpy Switchover (Economizer)

9. Peak Demand Limiting

10. Temperature Compensated Load Rolling

11. Fan Speed/CFM Control

12. Outside Air Intake CFM Monitoring

13. Heating/Cooling Interlock

14. Cold Deck Reset

15. Hot Deck Reset

16. Hot Water Reset

17. Compressor Sequencing

D. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization. Programs shall be applied to building equipment as described in the Execution portion of this specification.

E. Custom Process Programming Capability: DDC panels shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

1. Process Inputs and Variables: It shall be possible to use any of the following in a custom process:

a. Any system-measured point data or status

b. Any calculated data

c. Any results from other processes

d. User-Defined Constants

e. Arithmetic functions (+,-,*,/, square root, exp, etc.)

f. Boolean logic operators (and, or, exclusive or, etc.)

g. On-delay/Off-delay/One-shot timers

2. Process Triggers: Custom processes may be triggered based on any combination of the following:

a. Time interval

b. Time of day

c. Date

d. Other processes

e. Time programming

f. Events (e.g., point alarms)

3. Dynamic Data Access: A single process shall be able to incorporate measured or calculated data from any and all other DDC panels on the local area network.

   a. In addition, a single process shall be able to issue commands to points in any and all other DDC panels on the local are network.

4. Advisory/Message Generation: Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device, buffer the information in a follow-up file, or cause the execution to a dial-up connection to a remote device such as a printer of pager.

5. Custom Process Documentation: The custom control programming feature shall be self-documenting. All interrelationships defined by this feature shall be documented via graphic flowcharts and English language descriptors.

F. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each DDC panel shall perform distributed, independent alarm analysis and filtering to minimize network traffic, and prevent alarms from being lost. At no time shall the DDC panel's ability to report alarms be affected by either operator activity at a PC Workstation or local I/O device.

1. Point Change Report Description: All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.

2. Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Each DDC panel shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point. The user shall also be able to define under which conditions point changes need to be acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.

3. Report Routing: Alarm reports, messages, and files will be directed to a user-defined list of operator devices, or PCs used for archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.

4. Alarm Messages: In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 65-character alarm message to more fully describe the alarm condition or direct operator response. Each standalone DDC panel shall be capable of storing a library of at least 250 Alarm Messages. Each message may be assignable to any number of points in the panel.

5. Auto-Dial Alarm Management: In Dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.

G. Historical Data and Trend Analysis: A variety of Historical data collection utilities shall be provided to automatically sample, store, and display system date in all of the following ways.

1. Continuous Point Histories: Standalone DDC panels shall store Point History Files for all analog and binary inputs and outputs. The Point History routine shall continuously and automatically sample the value of all analog inputs at half hour intervals. Samples for all points shall be stored for the past 24 hours to allow the user to immediately analyze equipment performance and all problem-related events for the past day. Point History Files for binary input or output points and analog output points shall include a continuous record of the last ten status changes or commands for each point.

2. Control Loop Performance Trends: Standalone DDC panels shall also provide high resolution sampling capability with an operator-adjustable resolution of 10-300 seconds in one-second increments for verification of control loop performance.

3. Extended Sample Period Trends: Measured and calculated analog and binary date shall also be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of 1 minute of 2 hours, in one-minute intervals, shall be provided. Each standalone DDC panel shall have a dedicated buffer for trend date, and shall be capable of storing a minimum of 5000 data samples.

4. Data Storage and Archiving: Trend data shall be stored at the Standalone DDC panels, and uploaded to hard disk storage when archival is desired. Uploads shall occur based upon either user-defined intervals, manual command, or when the trend buffers become full. All trend data shall be available in disk file form for use in 3rd Party personal computer applications.

H. Runtime Totalization: Standalone DDC panels shall automatically accumulate and store runtime hours for binary input and output points as specified in the Execution portion of this specification.

1. The Totalization routine shall have a sampling resolution of one minute or less.

2. The user shall have the ability to define a warning limit for Runtime Totalization. Unique, user-specified messages shall be generated when the limit is reached.

I. Analog/Pulse Totalization: Standalone DDC panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

1. Totalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g. KWH, gallons, KBTU, tons, klbs (for steam), etc.).

2. The Totalization routine shall have a sampling resolution of one minute or less.

3. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

J. Event Totalization: Standalone DDC panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.

1. The Event Totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.

2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

2.12 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

A. Each Standalone DDC Controller shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASCs).

B. Each ASC shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.

C. Each ASC shall have sufficient memory to support its own operating system and date base including:

1. Control Processes

2. Energy Management Applications

3. Operator I/O (Portable Service Terminal)

D. The operator interface to any ASC point data or programs shall be through any network-resident PC workstation, or any PC or portable operator's terminal connected to any DDC panel in the network.

E. Application Specific Controllers shall directly support the temporary use of a portable service terminal. The capabilities of the portable service terminal shall include but not be limited to the following:

1. Display temperatures

2. Display status

3. Display setpoints

4. Display control parameters

5. Override binary output control

6. Override analog setpoints

7. Modification of gain and offset constants

F. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the controller.

G. Application Description:

1. AHU Controllers:

a. AHU Controllers shall support, but no be limited to, the following configurations of systems to address current requirements as described in the Execution portion of this specification.

b. AHU Controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally standalone fashion.

c. AHU controllers shall have a library of control routines and program logic to perform the sequence of operation as specified in the Execution portion of this specification.

d. Occupancy-Based Standby/Comfort Mode Control: Each AHU Controller shall have a provision for occupancy sensing overrides. Based upon the contact status of either a manual wall switch or an occupancy sensing device, the AHU Controller shall automatically select either Standby or Comfort mode to minimize the heating and cooling requirements while satisfying comfort conditions.

e. Continuous Zone Temperature Histories: Each AHU Controller shall automatically and continuously, maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.

f. Alarm Management: Each AHU Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

2.13 OPERATOR INTERFACE

A. Basic Interface Description:

1. Command Entry/Menu Selection Process: Operator Workstation interface software shall minimize operator training through the use of English language prompting, English language point identification, and industry standard PC application software.

2. The operator interface shall minimize the use of a typewriter style keyboard through the use of a mouse or similar pointing device, and "point and click" approach to menu selection. Users shall be able to start and stop equipment of change setpoints from graphical displays through the use of a mouse of similar pointing device.

3. Multiple, Concurrent Displays: The Operator Interface shall provide the ability to simultaneously view several different types of system displays in overlapping windows to speed building analysis. For example, the interface shall provide the ability to simultaneously display a graphic depicting an air handling unit, while displaying the trend graph of several associated space temperatures to allow the user to analyze system performance. If the interface is unable to display several different types of displays at the same time, the FMS contractor shall provide at least two operator stations.

4. Password Protection: Multiple-level password access protection shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.

    a. Passwords shall be exactly the same for all operator devices, including portable or panel-mounted network terminals. Any additions or changes made to password definition shall automatically cause passwords at all DDC panels on a network to be updated and downloaded to minimize the task of maintaining system security. Users shall not be required to update passwords for DDC panels individually.

    b. A minimum of five levels of access shall be supported:

        1) Level 1 = Date Access and Display

        2) Level 2 = Level 1 + Operator Overrides

        3) Level 3 = Level 2 + Database Modification

        4) Level 4 = Level 3 + Database Generation

        5) Level 5 = Level 4 + Password Add/Modification

    c. A minimum of 50 passwords shall be supported at each DDC panel.

    d. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device, including portable or panel mounted devices, shall be limited to only those items defined for the access level of the password used to log-on.

    e. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving devices on-line.

5. Operator Commands: The operator interface shall allow the operator to perform commands including, but not limited to, the following:

    a. Start-up of shutdown selected equipment

b. Adjust setpoints

c. Add/Modify/Delete time programming

d. Enable/Disable process execution

e. Lock/Unlock alarm reporting for each point

f. Enable/Disable Totalization for each point

g. Enable/Disable Trending for each point

h. Override PID Loop setpoints

i. Enter temporary override schedules

j. Define Holiday Schedules

k. Change time/data

l. Enter/Modify analog alarm limits

m. Enter/Modify analog warning lights

n. View limits

o. Enable/Disable Demand Limiting for each meter

p. Enable/Disable Duty Cycle for each load

6. Logs and Summaries: Reports shall be generated automatically or manually, and directed to either CRT displays, printers, or disk files. As a minimum, the system shall allow the user to easily obtain the following types of reports:

a. A general listing of all points in the network

b. List all points currently in alarm

c. List of all off-line points

d. List all points currently in override status

e. List of all disabled points

f. List all points currently locked out

g. List of all items defined in a Follow-Up file

h. List all Weekly Schedules

i. List all Holiday Programming

j. List of Limits and Deadbands

k. Summaries shall be provided for specific points, for a logical point group, for a user-selected group of groups, or for the entire facility without restriction due to the hardware configuration of the facility management system. Under no conditions shall the operator need to specify the address of hardware controller to obtain system information.

B. System Configuration and Definition: All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.

1. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently perform the following functions:

a. Add/Delete/Modify Standalone DDC Panels

b. Add/Delete/Modify Operator Workstations

c. Add/Delete/Modify Application Specific Controllers

d. Add/Delete/Modify points of any type, and all associated point parameters, and tuning constants

e. Add/Delete/Modify alarm reporting definition for each point

f. Add/Delete/Modify control loops

g. Add/Delete/Modify energy management applications

h. Add/Delete/Modify time- and calendar-based programming

i. Add/Delete/Modify Totalization for every point

j. Add/Delete/Modify Historical Data Trending for every point

k. Add/Delete/Modify custom control processes

l. Add/Delete/Modify any and all graphic displays, symbols, and cross-references to point data

m. Add/Delete/Modify dial-up telecommunication definition

n. Add/Delete/Modify all operator passwords

o. Add/Delete/Modify Alarm Messages

2. System Definition/Control Sequence Documentation: All portions of system definition shall be self-documenting to provide hardcopy printouts of all configuration and application data. Control process and DDC control loop documentation shall be provided in logical, graphical flow diagram format to allow control sequences to be easily interpreted and modified at any time in the future.

3. Database Save/Restore/Back-Up: Back-up copies of all standalone DDC panel databases shall be stored in at least one personal computer operator workstation. Continuous supervision of the integrity of all DDC panel data bases shall be provided. In the event that any DDC panel on the network experiences a loss of its data base for any reason, the system shall automatically download a new copy of the respective data base to restore proper operation. Data base back-up/Download shall occur over the local area network without operator intervention. Users shall also have the ability to manually execute downloads of any of all portions of a DDC panels data base.

C. Local laptop plugin station in electrical room required for command entry, information management, network alarm management, and database management functions. All real-time control functions shall be resident in the Standalone DDC panels to facilitate greater fault tolerance and reliability.

D. Standalone DDC panel Local or Portable Operator's Terminals: Each DDC panel shall be capable of supporting an operator's terminal for local command entry, instantaneous and historical data display, and program additions and modifications.

1. There shall be a provision for both permanently mounting the standalone DDC panel Operator Terminal, or using it as a portable handheld unit.

2. The DDC panel Operator Terminal shall simultaneously display a minimum of 6 points with full English identification to allow an operator to view single screen dynamic displays depicting entire mechanical systems.

3. The operator functions provided by the DDC panel Operator Terminal shall include, but not limited to, the following:

a. Start and Stop Points

b. Modify Setpoints

c. Modify PID Loop Setpoints

d. Override PID Control

e. Change Time/Date

f. Add/Modify Start/Stop Weekly Scheduling

g. Add/Modify Setpoint Weekly Scheduling

h. Enter Temporary Override Schedules

i. Define Holiday Schedules

j. View Analog Limits

k. Enter/Modify Analog Warning Limits

l. Enter/Modify Analog Alarm Limits

m. Enter/Modify Analog Differentials

n. View Point History Files

4. The DDC panel Operator Terminal shall provide access to all real or calculated points in the controller to which it is connected, or any other controller in the network. This capability shall not be restricted to a subset of predefined "global points", but shall provide totally open exchange of data between the operator terminal and any DDC panel in the network.

5. Operator access at all DDC panel Operator Terminals shall be identical to each other, as well as identical to the PC or Laptop Operator Workstations. Any password changes shall automatically be downloaded to all controllers on the network.

6. The DDC panel operator terminal shall provide English language prompting to eliminate the need for the user to remember command formats or point names. Prompting shall be provided consistent with a user's password clearance and the types of points being displayed, to eliminate the possibility of operator error.

7. A multi-function touchpad shall be provided for point and command selection, as well as parameter entry. To minimize the possibility of operator error, the DDC panel Operator Terminal shall change and limit touch pad functions based upon an operator's password clearance, the function being performed, and types of points being displayed. Screen displays shall clearly indicate only valid touchpad functions.

8. Context-Sensitive Help: On-line, interactive user's "Help" manuals and tutorials shall be provided. Based upon operator request, the "help" function shall provide general system operating instructions, and specific descriptions of commands available in the currently displayed menus.

9. Identification for all real or calculated points shall be consistent for all network devices. the same English language names used at PC workstations shall be used to access points at the DDC panel Operator's Terminal to eliminate cross-reference or look-up tables.

10. In addition to instantaneous summaries, the DDC panel Operator's Terminal shall allow a user to view a Point History field for system points. Pint History fields shall provide a record of value of analog points over the last 24 hours, at 30-minute intervals, or a record of the last ten status changes for binary type points.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Control component shall be installed in accordance with manufacturer's instructions. Control components shall be grouped wherever possible, and installed within local control panels. See plans for locations.

B. Controls Contractor shall supervise the installation of control valves, dampers, temperature sensors, pressure sensors, actuators and sensing wells.

C. Conduit and wiring for the temperature control system not specifically shown on the electrical prints shall be installed by electricians and mechanics employed by the Temperature Control Contractor. All wiring must be in accordance with local and national electrical codes. All electrical conduit wiring and wiring methods shall be in full compliance with requirements of the electrical section.

D. Provide and install duct smoke detectors as required. The Balancing Contractor shall direct the Controls Contractor on the proper location for installing the smoke detectors.

E. Thermostats or sensors mounted on outside walls shall be mounted on 1/4" minimum thickness cork or rigid fiberglass.

F. Identify each item mounted on the face of a control panel with an engraved phenolic label (1/4" high engraved letters minimum). Identify each item of control equipment (except room sensors and thermostats).

G. All control adjustments shall be accessible without use of a ladder.

H. All thermostats or temperature sensors in the conditioned space shall have blank locking covers.

I. Airflow measuring arrays installed in fan inlet volutes must be designed to withstand velocities encountered in this location. Mounting system is to be warranted against failure and consequent fan damage.

3.2 ELECTRIC ACTUATOR APPLICATION AND INSTALLATION

A. A weather shield shall be used if located outside. Ambient temperature rating of 122^{o}F shall not be exceeded through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary.

B. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator. Cords or conduit shall incorporate a drip leg if condensation is possible.

C. Application Requirements:

1. Airtight dampers shall be fully closed and leakage minimized during mounting of actuators. Both drive signal and spring return shall fully close dampers.

2. Where spring return actuators are required for freeze protection, the power circuit to the actuators shall be disconnected by hard wire interlock to the freeze-stat. Use of a signal input to the program to initiate spring return is not acceptable. Use of the control signal to drive the actuators closed in not acceptable.

3. Face and bypass shall be proportional spring return closed to face position.

4. Outside air dampers shall be proportional control (2-10vdc or 4-20ma), with mechanical spring to return damper to the normally closed position on power failure.

5. Relief air dampers shall be proportional control (2-10vdc or 4-20ma), with mechanical spring to return damper to the normally closed position on power failure.

6. Return air dampers shall be proportional control (2-10vdc or 4-20ma), with mechanical spring to return damper to the normally open position on power failure.

7. Exhaust air dampers shall be On/Off control, spring return to normally closed position.

8. Combustion air intake dampers shall be On/Off control, spring return to open position.

9. Inlet vane actuators shall be floating or proportional control (2-10vdc or 4-20ma), non-spring.

10. Provide sufficient torque as velocity, static, or side seals require per damper manufacturer’s recommendation. In all cases torque shall be a minimum 5-in-lb per sq ft for opposed blade dampers and 7-in-lb per sq ft for parallel blade dampers. No individual damper section may exceed 20 sq ft.

3.3 SYSTEM OPERATION

A. It shall be the Control Contractor's responsibility to coordinate requirements with equipment suppliers, and furnish and install all control devices necessary to provide the control sequence specified, where not furnished by others. This is to include control transformers, room or insertion thermostats, and other devices without limitation.

3.4 OPERATOR INSTRUCTION

A. During system commissioning and at such time acceptable performance of the control hardware and software has been established, the Control Contractor shall provide on-site operator instruction to the Owner's operating personnel. Operator instruction during normal working hours shall be performed by a competent representative familiar with the system hardware, software, and accessories.

B. At a time mutually agreed upon during system commissioning as stated above, the System Contractor shall give instruction to the Owner's designated personnel on the operation of the Control systems and describe its intended use with respect to the programmed functions specified. Operator orientation of the control system shall include, but not 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. Twenty-Four Hour Initial Training - three day training 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 Owner's personnel can start to familiarize themselves with the system before classroom instruction.

2. First Four Hour Follow-up - approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.

3. Two Day Warranty Follow-Up - 8 hours in no less than 4 hour increments, to be scheduled at the request of the Owner during the warranty period. These sessions shall cover topics as requested by the Owner, including how to install additional points and add local control modules.

3.5 OPERATION AND MAINTENANCE MANUAL

A. Provide the Owner with the manual containing all instructions for operations and maintenance of all components at least 30 days prior to substantial completion and/or at least 15 days prior to Initial Training sessions.

B. Manual will contain all copies of AS-BUILT control drawings and schematics.

C. Manual shall contain manufacturer's catalog data and shop drawings for all control components.

D. Post a copy of the final sequence of operation and control drawings, under glass, in the mechanical room adjacent the main control panel.

E. Provide the list of spare parts in the manual.

END OF SECTION

VARIABLE FREQUENCY DRIVES (VFD)

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. Furnish complete and operational VFD systems as shown on the plans. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Variable frequency drives (VFDs).

2. Controls and control connections.

3. Electrical power connections.

1.3 RELATED WORK IN OTHER SECTIONS

A. Section 230500: Basic Materials and Methods

B. Section 230593: Testing, Adjusting and Balancing

C. Section 230900: Controls and Instrumentation

D. Section 232123: Pumps and Hydronic Specialties

E. Section 233412: Air Handling Equipment

F. Division 26: Coordination of interface items between the Mechanical equipment and controls and the Electrical Work specified in Division 26.

1.4 QUALITY ASSURANCE

A. Supplier of VFD shall be solely responsible for assuring that the VFD shall work properly with the motor(s) being controlled. VFD supplier shall provide all materials and labor required to replace motors, bearing, shafts, etc. that may be incompatible with VFD or become damaged by VFD at no additional cost to the owner. VFD supplier shall reimburse Architect and Engineer at their standard hourly rates for their involvement in resolving failures due to their VFDs.

B. Manufacturer shall have a minimum of 15 years experience building similar equipment for controlling the speed for induction motors and at least one hundred successful installations with a variety of VFD sizes and applications.

C. To insure quality and minimize failures the VFD(s) and connected motor(s) shall be by one manufacturer. To reduce the known problem of bearing failures by "fluting" the VFD switching rates shall be 6-8 Khz wherever possible. Manufactured VFDs at switching rates of 12-15 Khz shall be accompanied by an additional extended warranty to cover bearings and motors to a period of ten (10) years. Should it be impossible to provide matched motor and VFD's provide a shaft grounding system for the driven motor. Acceptable manufacturer are Shaft Grounding Systems (www.shaft-grounding-systems.com) or Aegis Shaft Grounding Ring (www.est-aegis.com).

D. To insure quality and minimize infantile failures at the job site, the VFD shall be burned in at the factory at an ambient of 104°F minimum for at least 8 hours. The VFD shall be operating a dynamometer and the load speed shall be cycled during the test. All optional and special features shall be functionally tested at the factory for proper operation.

E. Codes and Standards: Provide VFDs conforming to the requirements of the latest addition of the following:

1. ANSI/EIA 508Electrical Performance Standards for Television Broadcast Transmitters

2. UL508. All VFD equipment provided under this section must be labeled as UL508 approved.

3. ANSI/IEEE 518Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources.

4. ANSI/IEEE 519-1992: IEEE Recommended Practices and Requirements for Harmonic Control in Electrical power systems.

1.5 SUBMITTALS

A. Prior to construction submit for approval the following materials:

1. VFD supplier shall provide reference list showing at least ten years of prior manufacturing experience in production of VFDs and a list of at least twenty successful installations with a variety of VFD sizes and applications.

2. Manufacturer's data, installation instructions, and maintenance and operational instructions for variable frequency drives. Indicate electrical service and special requirements. Include manufacturer's descriptive literature, repair data, and parts listing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Protect units against dirt, water, chemical, and mechanical damage. Do not install damaged units. Remove damaged equipment from site.

1.7 WARRANTY

A. Provide two-year (24 months) warranty under provisions of Division 01. Provide extended ten (10) year warranty on motors and bearings as described above, if applicable. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory authorized service.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. ABB – No Exceptions

2.2 GENERAL

A. Furnish a complete VFD as scheduled on the plans. Refer to plans for locations of variable speed controllers. Each fan or pump motor shall have a dedicated VFD unit. All standard and optional features shall be included within the VFD enclosure unless otherwise specified. The VFD enclosure shall be provided to match the environment requirements where the VFD will be mounted and operated. Provide NEMA rated enclosure as required.

B. The adjustable frequency controller shall convert three-phase, 60 Hz utility power to adjustable voltage and frequency, three-phase, AC power for stepless motor speed control from 10% to 100% of the motor's 60 Hz speed.

C. The VFD shall include a converter and an inverter section. The converter section shall convert fixed frequency and voltage AC utility power to a DC voltage. Drive shall utilize a single surface mount micro-processor.

D. The VFD shall be of the pulse width modulation (PWM) type. VFDs shall be provided with an advanced flux vector frequency control to limit noise at drive and motor.

E. Drive manufacturer or sales representative shall evaluate electrical system of the project. Any additional protective equipment such as line filters, reactors or input isolation transformers required to prevent interference from drive with other electrical equipment in the building shall be included as part of the bid. No additional expense shall be incurred by Owner for provision or installation of these devices if required for electrical system operation after drive has been purchased. Units shall include factory mounted input line reactors.

F. The VFD maximum output current rating shall be 110% of the motor nameplate full load current. VFD shall be able to start into a rotating load in either direction without trip.

G. The VFD and options shall be tested to ASNI/EIA Standard 508 and listed by a nationally recognized testing agency such as UL or ETL.

H. The VFD and options shall comply with the applicable requirements of the latest standards of ANSI, IEEE, and the National Electrical Code.

I. Power line noise shall be limited to a voltage distortion factor and line notch depth as defined in ANSI/IEEE Standard 519.

J. The drive efficiency shall be 97% (minimum) and have a fundamental power factor of 0.98 at all speeds.

2.3 BASIC FEATURES

A. The VFD shall be housed in a NEMA enclosure appropriate to the mounting location.

1. NEMA 12 enclosure shall be used for dusty locations, plenum mechanical rooms, penthouses, or air stream mounting.

2. NEMA 3R is required for all locations exposed to falling rain, snow or ice or to indoor locations subject to falling water.

3. If NEMA 1 enclosure is suitable it shall be louvered, vented through cabinet using a removable louver/filter, and equipped with an integral cooling fan with thermostat control, and arranged so that units can be mounted back to back on a frame and/or side to side on a wall. Venting fans shall be supplied in enclosure if required. If a different NEMA enclosure is indicated the enclosure shall provide means of maintaining the drive at temperature acceptable to the drive manufacturer in exterior ambient temperatures. Enclosure shall be complete with no requirements for low voltage wiring. Factory mounted main circuit breaker disconnect shall be included.

B. The following operator controls shall be located on the front of the enclosure:

1. Door mounted operator digital controls consisting of auto/manual switch, start/stop switch with reset and manual speed control. In the auto position, the drive will start/stop from a remote contact closure and motor speed is determined by the follower signal. In the manual position, motor speed is determined by manual speed selection. Manual potentiometers are not acceptable.

2. Power on pilot light to indicate that the VFD is being supplied by the power line.

3. Fault digital display to indicate that the VFD has tripped on a fault condition. The drive shall retain in memory the last three (3) fault conditions that caused the drive to trip. Indication should include but not be limited to the following: Under voltage, over voltage, overcurrent, over temperature, phase loss, phase imbalance and external trip.

4. Digital display to indicate voltage, current, frequency or RPM. Selectable by the operator while the VFD is running.

C. VFD shall be provided with two (2) each form C dry contacts for indication of run and fault starters. In addition each drive shall have an analog output signal 0 to 10_{VDC} (or $4\text{-}20_{MA}$)to indicate drive speed (percent of full load).

D. While in the remote mode, the VFD will attempt at least five (5) restarts after a power outage, drive fault or external fault before requiring manual reset. After ten minutes of runtime, the restart attempts return to zero. The VFD shall display a countdown timer when auto restart is being attempted, or incorporate programming to select number of restarts, number of faults per time period, and time between restarts.

2.4 PROTECTIVE FEATURES

A. Protection against input transient voltage spikes.

B. Overload protection for the motor. If power input or output is interrupted while the control is in operation, no damage shall result. The unit shall be able to operate without any equipment connected to the inverter output. The drive must protect itself against all phase-to-phase short circuits and ground faults.

C. Protection against input power undervoltage, overvoltage and phase loss.

D. Protection against output current overload and overcurrent.

E. Protection against over-temperature within the VFD enclosure.

F. Protection against overvoltage on the DC bus.

G. Drive shall have an auxiliary contact to permit a remote trip.

H. DC bus discharge circuit and warning light for protection of service personnel or meet UL requirements for DC bus discharge.

I. Drive shall be capable of operating and insensitive to imbalance or out-of-rotation incoming power phase

J. Lockable main fused input disconnect shall be factory mounted as specified on the drawings or as required by the application.

2.5 ADJUSTMENTS

A. Maximum speed, adjustable to 100% base speed.

B. Minimum speed, adjustable to 10% base speed.

C. Acceleration time, adjustable 1 to 360 seconds (minimum) factory set at 20 seconds.

D. Deceleration time, adjustable 1 to 360 seconds (minimum) factory set at 20 seconds.

E. Current limit, adjustable 50 to 110%.

F. Adjustable speed lock-outs for three (3) operating ranges.

G. Capable of following 0-5$_{MA}$, 4-20$_{MA}$, 10-50$_{MA}$, 0-4$_{VDC}$, 0-8$_{VDC}$, 0-10$_{VDC}$ grounded or ungrounded signal as required to interface with the building control system.

2.6 SERVICE CONDITIONS

A. The VFD shall be designed to operate within the following service conditions:

1. Ambient temperature, 32°F-104°F.

2. Relative humidity, 5-95%, non-condensing.

3. Elevation to 3,300 feet without derating.

4. AC line voltage variation, -10% to +10% of nominal.

2.7 SPECIAL FEATURES

A. All control wiring, and accessories shall be factory installed in the drive casing so that only the connection of the remote auxiliary start/stop and override contacts is required to provide override control as described above.

B. All drives shall be equipped with fail safety speed control (adjustable 20-100%), factory installed and wired, that operates as follows: If the drive is on (in either normal or override mode) and no signal is detected from the building control system, the drive shall operate at a preset adjustable speed. On resumption of the building control system signal, the drive shall operate as normal. Fail safe speed shall be adjusted through digital keyboard mounted on the outside drive cabinet.

C. Drives shall be protected with input line reactors factory mounted.

D. Provide drive with a communications board enabling it to communicate with the building management system (BMS) over a serial RS-485 interface or with a BACNET, LonWorks, Modbus, Profibus or BMS proprietary interface.

2.8 BYPASS (WHEN SCHEDULED)

A. Provide a manual 3-contactor bypass consisting of a door interlocked main fused disconnect padlockable in the off position, a built-in motor starter and a three position DRIVE/OFF/BYPASS/TEST switch controlling three contactors. In the DRIVE position the motor is operated at an adjustable speed from the VFD. In the OFF position, the motor and VFD are disconnected. In the BYPASS position, the motor is operated at the full speed from the AC power line and power is disconnected from the VFD so that service can be performed. Include motor thermal overload and fuse or circuit breaker protection while in bypass operation.

B. Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power using a specially designed tool and mechanism while meeting all local and national code requirements for safety.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify that mounting surface is ready to receive work. Mount the VFD(s) on the wall or at supports in locations identified on the drawings. Provide a layout drawing of VFD locations to electrical installer.

B. If the disconnect for the equipment powered by the VFD is in a location where it is probable that it will be placed in an off position prior to shutting down the VFD, the contractor is to provide electrical protection for the VFD. This may be in the form of a conduit and wire interlock between disconnect and drive or internal protection integral to the VFD.

C. Coordinate wiring and control with Control Contractor. Control installers shall install all wiring associated with control signals into the VFD and for interlock control wiring between disconnects and VFDs.

D. Electrical installer shall install all line voltage power wiring and conduit from electrical switchgear and from the VFD to the disconnect at the controlled motor. The only exception to this is when the motor and drive are factory installed on a packaged piece of equipment. In that case the wiring from drive to motor is to be installed in the factory to meet the requirements herein. Coordinate with Division 26 work.

E. Line length between VFD and driven motor shall be as short as possible. Line length shall not exceed twenty (20) feet without prior approval from Engineer.

F. Input and output power wiring shall be installed in separate grounded conduit. In addition, control wiring shall be installed in its own separate grounded conduit.

G. Use symmetric motor cable between the VFD and motor, with low inductance shield or conduit, and with all joints joined with bonding straps. MC metal clad 3 phase type cable per NEC 334-1, UL approved, 3 phase conductors and 3 ground conductors. Sheath to be continuous corrugated aluminum. Manufacturer and type to be BICC 2 kV rated Drives Cable, Anixter series 7V, or approved equal.

H. Use cable connectors with 360 degree connections to the armor conduit at both ends of motor cable. Verify electrical path from inverter cabinet entry plate to armor / conduit to motor terminal box.

I. Install an auxiliary high frequency bonding connection for potential equalization between VFD frame and building steel.

J. Unless absolutely necessary do not install disconnect between VFD and connected motor. VFD is to be furnished with a lockable disconnect.

K. Installation in “Fan Wall “ Air Handlers: When a single VFD supplies multiple fans, assemble and prewire units at the factory, installing conduit and conductors between the fan motor, VFD, and terminal strips. Wiring from the VFD output terminals to the fan motor shall be Belden VFD Cable installed in conduit (295XX Series).

3.2 MANUFACTURER'S START-UP SERVICES

A. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify control wiring, verify power wiring, start-up the drive, and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Harmonic test with scope shall be also performed at the job site and results submitted to the Owner's Representative. Fully staffed parts and service personnel shall be within four hours travel from the jobsite.

B. Carrier Frequency Set up:

1. Set initial carrier frequency at 2 kHz.

2. Manually raise VFD speed output from 10 Hz to 60 Hz by 10 Hz increments, allowing at least 15 seconds between each adjustment. If excessive motor noise is heard at any speed, raise carrier frequency by 2 kHz increments until motor noise is no longer excessive. Do not set carrier frequency higher than 10 kHz.

3. If excessive motor noise continues to be heard at or below 10 kHz, inform owner. If the motor is provided by the VFD manufacturer, either repair, replace, or provide 5 year extended warranty on the effected motor.

C. Lockout of resonant frequencies:

1. With carrier frequency set per the above specification, manually and slowly raise VFD speed output from 10 Hz to 60 Hz by 1 Hz increments. If excessive motor, frame, or driven load noise is heard at any speed, lock out that frequency.

2. Each frequency skip shall be programmed with as narrow a bandwidth as possible, while still avoiding the most objectionable range of resonant frequencies. Each frequency skip bandwidth shall not exceed 5 Hz without approval by Engineer.

D. Training:

1. Provide 1 hour training session to the owner’s representative.

2. Training to include

a. Demonstration of operation of bypass switch and door-mounted disconnect switches. Explain emergency operation.

b. Demonstrate operation of operator keypads for viewing data and setting parameters.

c. Demonstrate operation in manual mode, including setting of specific speeds.

d. Explain the drive parameters that might require operator adjustment.

e. Describe troubleshooting techniques and warranty procedure.

END OF SECTION

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

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 control sequences for HVAC systems, subsystems, and equipment.

B. Related Sections include the following:

1. Section 230900 "Building Automation System (BAS) Controls "for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

A. BAS: Building Automation System

B. DDC: Direct digital control.

C. VAV: Variable air volume.

1.4 ABBREVIATIONS

A. The following abbreviations may be used in graphics, schematics, point names, and other UI applications where space is at a premium.

1. AC - Air Conditioning
2. ACU - Air Conditioning Unit
3. AHU - Air Handling Unit
4. AI - Analog Input
5. AO - Analog Output
6. AUTO – Automatic
7. AUX – Auxiliary
8. BI -Binary Input
9. BO -Binary Output
10. C –Common
11. DA - Discharge Air

12. EA - Exhaust Air
13. EF - Exhaust Fan
14. EVAP – Evaporators
15. FCU - Fan Coil Unit
16. HOA - Hand / Off / Auto
17. HP - Heat Pump
18. HRU - Heat Recovery Unit
19. HTEX - Heat Exchanger
20. HW - Hot Water
21. HWP - Heating Water Pump
22. HWR – Heating Water Return
23. HWS - Heating Water Supply
24. MAX – Maximum
25. MIN – Minimum
26. MISC – Miscellaneous
27. NC - Normally Closed
28. NO - Normally Open
29. OA - Outdoor Air
30. RA - Return Air
31. RF - Return Fan
32. RH - Relative Humidity
33. RTU - Roof-top Unit
34. SA - Supply Air
35. SF - Supply Fan
36. SP - Static Pressure

37. TEMP – Temperature

38. UH - Unit Heater

39. UV - Unit Ventilator

40. VAV - Variable Air Volume

41. VVTU - Variable Volume Terminal Unit

42. W/ - with

43. W/O – without

PART 2 - PRODUCTS (Not Applicable – Refer to 230900)

PART 3 - EXECUTION

3.1 WINDOW SENSOR & HVAC CONTROL INTEGRATION

A. Window Sensor Control: Manually operable windows in new areas of construction are each to be equipped with a window sensor to provide indication of open/closed status of the window. See zoning plans for sensor locations.

1. For single room zones or multi-room zones, monitor window sensors. If any window in the zone is open, lock out zone heating and cooling. Close VAV damper and reheat function. Remove zone from SA temperature reset algorithm and duct static pressure reset algorithm. Provide an alarm if space temperature falls below night setback temperature and activate heating.

3.2 VARIABLE AIR VOLUME TERMINAL UNIT – ELECTRIC REHEAT WITH CARBON DIOXIDE (CO2) MONITORING

A. Features

1. Cooling damper and actuator

2. Electric reheat coil

3. Carbon dioxide monitoring (where noted on zoning plans)

4. All setpoints shall be user adjustable

B. Run Conditions - Scheduled: The unit shall run according to a user definable time schedule and maintain the following modes:

1. Occupied Mode Temperatures:

a. Cooling setpoint - 75°F

b. Heating setpoint - 70°F

2. Unoccupied Mode Temperatures (night setback):

a. Cooling setpoint - 85°F

b. Heating setpoint - 55°F

3. Four air flow control setpoints shall apply as follows:

a. Occupied cooling maximum air flow as scheduled

b. Occupied heating maximum air flow as scheduled

c. Occupied cooling/heating minimum air flow as scheduled

d. Unoccupied cooling/heating minimum air flow as scheduled

4. Alarms shall be provided as follows:

a. High Zone Temp: If the zone temperature is 5°F greater than the cooling setpoint.

b. Low Zone Temp: If the zone temperature is 5°F less than the heating setpoint.

C. Minimum Ventilation on Carbon Dioxide (CO2) Concentration: When in the occupied mode, the BAS shall measure the zone CO2 levels and modulate the zone damper open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoint of not more than 800 ppm above ambient outside air CO2 concentration.

1. Alarms shall be provided as follows:

a. High Zone Carbon Dioxide Concentration: If the zone CO2 concentration is greater than 1500 ppm.

b. Zone Setpoint Adjust: The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

c. Zone Unoccupied Override: A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

D. Air Flow Control: The unit shall maintain zone setpoints by controlling the airflow through one of the following:

1. Occupied:

a. When zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum occupied airflow and the maximum cooling airflow until the zone is satisfied.

b. When the zone temperature is between the cooling setpoint and the heating set-point (deadband), the zone damper shall maintain the minimum required zone ventilation. The volume of air in the deadband shall not exceed the larger of 20% of peak primary airflow or the design zone ventilation rate.

c. When the zone temperature is less than its heating set-point, the BAS shall enable heating and maintain room temperature setpoint by modulating the reheat capacity to increase the supply air temperature up to maximum supply air temperature of 95°F while airflow is kept at the deadband flow rate. Upon a further call for heating, the zone damper shall modulate between the minimum occupied airflow and the maximum heating airflow, and the reheat capacity shall modulate to maintain the maximum supply air temperature, until the zone is satisfied. The maximum volume of primary air that is reheated shall not exceed the larger of 50% of peak primary airflow or the design zone ventilation rate.

2. Unoccupied:

a. When the zone is unoccupied the zone damper shall control to its minimum unoccupied airflow.

b. When the zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum unoccupied airflow and the maximum cooling airflow until the zone is satisfied.

c. When zone temperature falls below heating setpoint, the BAS shall enable heating and reheat coil to maintain the zone temperature at its heating setpoint.

E. Electric Reheat Coil: The BAS shall measure the zone temperature and energize the electric reheat coils on dropping temperature to maintain its heating setpoint per a variable SCR control strategy.

F. Reheating - High Discharge Air Temperature Limit: The BAS shall measure the discharge air temperature and limit reheating if the discharge air temperature is more than 25°F above the zone temperature.

G. Discharge Air Temperature: The BAS shall monitor the discharge air temperature.

1. Alarms shall be provided as follows:

a. High Discharge Air Temperature: If the discharge air temperature is greater than 120°F.

b. Low Discharge Air Temperature: If the discharge air temperature is less than 40°F.

H. Occupancy Sensor Operation (provided by div 26 – auxiliary contact connection):

1. When space is occupied the terminal unit control sequence shall function as previously stated for the occupied mode.

2. When space is unoccupied the terminal unit control sequence shall function as previously stated for unoccupied mode.

3.3 VARIABLE AIR VOLUME AIR HANDLING UNIT – AIR COOLED HEAT PUMP (MULTI-ZONE)

A. Features

1. Direct expansion refrigeration coil
2. Reversing valve integration for heating
3. Auxiliary electric heat
4. Supply fan air flow monitoring
5. Return fan air flow monitoring
6. Outside air flow monitoring
7. Dry-bulb air economizer
8. Trim and respond static air pressure reset
9. Trim and respond supply air temperature reset
10. Humidity monitoring
11. All setpoints shall be user adjustable

B. Run Conditions - Requested:

1. The unit shall run whenever:
   a. Per building schedule
   b. Any zone is occupied.
   c. Or, a definable number of unoccupied zones need heating or cooling.

C. Alarms shall be provided as follows:

1. Supply Air Smoke Detection: The unit shall shut down and generate an alarm upon receiving a supply air smoke detector status.
2. Return Air Smoke Detection: The unit shall shut down and generate an alarm upon receiving a return air smoke detector status
3. High Static Shutdown: The unit shall shut down and generate an alarm upon receiving a high static shutdown signal. The fans shall be shut down through a duct static pressure high limit switch. The switch shall be set to trip at a pressure that is 20% greater than the

maximum design working pressure or 75% of the supply duct SMACNA pressure rating, whichever is greater.

4. Freeze Protection: The unit shall shut down and generate an alarm upon receiving a freezestat status.

D. AHU Optimal Start: The unit shall start prior to scheduled occupancy based on the time necessary for the zones to reach their occupied setpoints. The start time shall automatically adjust based on changes in outside air temperature and zone temperatures.

E. Supply Fan: The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties.

1. Alarms shall be provided as follows:

a. Supply Fan Failure: Commanded on, but the status is off.

b. Supply Fan in Hand: Commanded off, but the status is on.

c. Supply Fan VFD Fault.

F. Supply Air Duct Static Pressure Control: The BAS shall measure duct static pressure and shall modulate the supply fan VFD speed to maintain a duct static pressure setpoint as follows:

1. The base duct static pressure setpoint shall be set to 1.5 inches H2O. (Note to Editor – modify initial duct static setpoint depending on design requirements. Initial setpoint may need to be adjusted during test and balance.)

2. As cooling demand increases, the setpoint shall incrementally reset up to a maximum of 0.5 inches H2O above the base static pressure setpoint.

3. As cooling demand decreases, the setpoint shall incrementally reset down to a minimum of 0.25 inches H2O below the base static pressure setpoint.

4. The fan VFD speed(s) shall not drop below 15 Hz, or as recommended by manufacturer.

5. Alarms shall be provided as follows:

a. High Supply Air Static Pressure: If the supply air static pressure is 1.0 inches H2O greater than setpoint.

b. Low Supply Air Static Pressure: If the supply air static pressure drops to 0.5 inches H2O.

G. Return Fan: The return fan shall run whenever the supply fan runs.

1. Alarms shall be provided as follows:

a. Return Fan Failure: Commanded on, but the status is off.

b. Return Fan in Hand: Commanded off, but the status is on.

c. Return Fan VFD Fault.

H. Return Fan Speed Control: The BAS shall modulate the return fan speed by the greater of the two following control loops:

1. The supply fan VFD signal shall be utilized for the primary control loop to determine the cfm setpoint of the return fans sensed by the VFD speed signal. The cfm setpoint shall be used to establish a linear relationship from the signal established during the air balance based on the maximum measured supply cfm less any cfm required to maintain the building at +0.05" wc, and.

2. The secondary control loop shall be based on maintaining a positive pressure in the exhaust air plenum by modulating the exhaust air dampers to maintain an exhaust plenum pressure of +0.02" wc minimum to 0.07" wc maximum.

3. The fan VFD speed(s) shall not drop below 15 Hz, or as recommended by manufacturer.

4. Alarms shall be provided as follows:

a. High Return Air Static Pressure: If the return air static pressure is 1.0 inches H2O greater than setpoint.

b. Low Return Air Static Pressure: If the return air static pressure drops to 0.25 inches H2O.

I. Supply Air Temperature Setpoint - Optimized: The BAS shall monitor the supply air temperature and shall maintain a supply air temperature setpoint reset based on zone cooling requirements.

1. The supply air temperature setpoint shall be reset for cooling based on zone cooling requirements as follows:

a. The initial supply air temperature setpoint shall be 55°F.

b. As cooling demand increases, the setpoint shall incrementally reset down to a minimum of 53°F.

c. As cooling demand decreases, the setpoint shall incrementally reset up to a maximum of 72°F.

J. Cooling Stages:

1. The BAS shall measure the supply air temperature and stage the cooling to maintain the cooling setpoint. To prevent short cycling, there shall be a user definable delay between stages, and each stage shall have a user definable minimum runtime.

2. The cooling shall be enabled whenever:

   a. The economizer mode (if present) is disabled and the outside air temperature is not sufficient to meet the cooling demands.

   b. And, the supply fan status is on.

3. Alarms shall be provided as follows:

   a. High Supply Air Temperature: If the supply air temperature is 5°F greater than setpoint.

   b. Low Supply Air Temperature: If the supply air temperature is below 40°F.

K. Heating Stages:

1. The BAS shall measure the supply air temperature and stage the heating to maintain the cooling setpoint.

2. The heating shall be enabled whenever:

   a. The supply fan status is on.

   b. And, the cooling or economizer is not active.

   c. And, the supply air temperature is below cooling setpoint

3. The heating shall stage on whenever:

   a. Supply air temperature drops to 35°F.

   b. Or, the freezestat (if present) is enabled and heating coil is upstream of evaporate coil.

4. Alarms shall be provided as follows:

   a. Low Supply Air Temperature: If the supply air temperature is 5°F less than set-point.

L. Supplemental Electric Heating Stage: Used for defrost mode & backup heat.

M. Air Economizer: The BAS shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position per design and as determined by the test and balance contractor whenever occupied.

1. The economizer shall be enabled whenever:

   a. Outside air temperature is less than 65°F.

b. And, the outside air temperature is less than the return air temperature.

c. And, the supply fan status is on.

2. The economizer shall close whenever:

a. Mixed air temperature drops below the supply air temperature required to meet the cooling demand.

b. Or, the freezestat (if present) is energized.

c. Or, on loss of supply fan status.

N. The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If optimal start up is available the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed position.

O. Minimum Outside Air Ventilation: When in the occupied mode, the BAS shall measure the outside airflow and modulate the outside air dampers to maintain the proper minimum outside air ventilation, overriding normal damper control. On dropping outside airflow, the BAS shall modulate the outside air dampers open to maintain the outside airflow setpoint.

P. Minimum Outside Air Ventilation - Carbon Dioxide (CO2) Control: When in the occupied mode, the BAS shall monitor zone CO2 levels served by this air handling unit. The BAS shall take the highest zone CO2 level and modulate the outside air damper(s) open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoints defined by vav terminal unit logic

Q. Pre-occupancy: The air handler shall be energized a minimum of one half hour prior to scheduled occupied period to circulate design minimum ventilation air throughout the building. Temperature control may continue to function per the un-occupied schedule.

R. Prefilter Differential Pressure Monitor: The BAS shall monitor the differential pressure across the prefilter.

1. Alarms shall be provided as follows:

a. Prefilter Change Required: Prefilter differential pressure exceeds a user definable limit initially set to 0.5” wg above clean filter differential static pressure.

S. Final Filter Differential Pressure Monitor: The BAS shall monitor the differential pressure across the final filter.

1. Alarms shall be provided as follows:

a. Final Filter Change Required: Final filter differential pressure exceeds a user definable limit initially set to 1.0” wg above the clean filter differential static pressure.

T. Mixed Air Temperature: The BAS shall monitor the mixed air temperature and use as required for economizer control or preheating control.

1. Alarms shall be provided as follows:

a. High Mixed Air Temperature: If the mixed air temperature is greater than 90°F.

b. Low Mixed Air Temperature: If the mixed air temperature is less than 40°F.

U. Return Air Humidity: The BAS shall monitor the return air humidity and use as required for economizer control.

1. Alarms shall be provided as follows:

a. High Return Air Humidity: If the return air humidity is greater than 70% RH.

b. Low Return Air Humidity: If the return air humidity is less than 35% RH.

V. Return Air Temperature: The BAS shall monitor the return air temperature and use as required for setpoint control or economizer control (if present).

1. Alarms shall be provided as follows:

a. High Return Air Temperature: If the return air temperature is greater than 90°F.

b. Low Return Air Temperature: If the return air temperature is less than 45°F.

W. Supply Air Temperature: The BAS shall monitor the supply air temperature.

1. Alarms shall be provided as follows:

a. High Supply Air Temperature: If the supply air temperature is greater than 120°F.

b. Low Supply Air Temperature: If the supply air temperature is less than 45°F.

3.4 VARIABLE AIR VOLUME AIR HANDLING UNIT–AIR COOLED HEAT PUMP (SINGLE-ZONE)

A. Features

1. Direct expansion refrigeration coil

2. Reversing valve integration for heating

3. Auxiliary electric heat

4. Supply fan air flow monitoring

5. Return fan air flow monitoring

6. Outside air flow monitoring

7. Dry-bulb air economizer

8. Trim and respond static air pressure reset

9. Trim and respond supply air temperature reset

10. Humidity monitoring and active control

11. All setpoints shall be user adjustable

B. Run Conditions - Requested:

1. The unit shall run whenever:

a. Per building schedule

b. The zone is occupied.

c. Or, the zone is unoccupied but needs heating or cooling to maintain unoccupied temperature setpoings.

C. Alarms shall be provided as follows:

1. Supply Air Smoke Detection: The unit shall shut down and generate an alarm upon receiving a supply air smoke detector status.

2. Return Air Smoke Detection: The unit shall shut down and generate an alarm upon receiving a return air smoke detector status

3. High Static Shutdown: The unit shall shut down and generate an alarm upon receiving a high static shutdown signal. The fans shall be shut down through a duct static pressure high limit switch. The switch shall be set to trip at a pressure that is 20% greater than the maximum design working pressure or 75% of the supply duct SMACNA pressure rating, whichever is greater.

4. Freeze Protection: The unit shall shut down and generate an alarm upon receiving a freezestat status.

D. AHU Optimal Start: The unit shall start prior to scheduled occupancy based on the time necessary for the zones to reach their occupied setpoints. The start time shall automatically adjust based on changes in outside air temperature and zone temperatures.

E. Supply Fan:

1. The supply fan shall run continuously during occupied periods, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable minimum runtime.

2. Supply Air Room Temperature Control: The BAS shall the zone temperature (take average of (2) room sensors) and shall modulate the supply fan VFD speed to maintain the room zone setpoint.

3. Alarms shall be provided as follows:

   a. Supply Fan Failure: Commanded on, but the status is off.

   b. Supply Fan in Hand: Commanded off, but the status is on.

   c. Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit.

F. Cooling:

1. The BAS shall measure the zone temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, there shall be a user definable delay between stages, and each stage shall have a user definable minimum runtime.

2. The cooling shall be enabled whenever:

   a. There is a call for cooling.

   b. And, the economizer is disabled or fully open.

   c. And, the zone temperature is above cooling setpoint.

   d. And, the supply fan status is on.

   e. And, the heating is not active.

G. Heating:

1. The BAS shall measure the zone temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, there shall be a user definable delay between stages, and each stage shall have a user definable minimum runtime.

2. The heating shall be enabled whenever:

   a. There is a call for heating.

   b. And, the zone temperature is below heating setpoint.

   c. And, the supply fan status is on.

   d. And, the cooling is not active.

H. Dehumidification:

1. The BAS shall measure the zone humidity level and stage cooling & electric reheat function to dry out the supply air and heat if required to maintain current cooling or heating setpoint. To prevent short cycling, there shall be a user definable delay between stages, and each stage shall have a user definable minimum runtime.

2. The dehumidification shall be enabled whenever:

   a. There is a call for dehumidification.

   b. And, the zone humidity level is below setpoint.

   c. And, the supply fan status is on.

I. Supply Air Temperature (integrated and modulated economizer operation):

1. The BAS shall monitor the supply air temperature and use as required for integrated economizer control.

2. Alarms shall be provided as follows when in economizer operation:

   a. High Supply Air Temperature: If the supply air temperature is greater than 72°F.

   b. Low Supply Air Temperature: If the supply air temperature is less than 45°F.

J. Supply Air Temperature in heating or cooling mode:

1. The BAS shall monitor the supply air temperature and use as required for cooling and heating control:

   a. High supply air temperature in cooling mode: If the supply air temperature is greater than 75°F.

   b. Low supply air temperature in cooling mode: If the supply air temperature is less than 45°F.

   c. High supply air temperature in heating mode: If the supply air temperature is greater than 110°F.

   d. Low supply air temperature in heating mode: If the supply air temperature is less than 80°F.

K. Return Fan: The return fan shall run whenever the supply fan runs.

1. Alarms shall be provided as follows:

   a. Return Fan Failure: Commanded on, but the status is off.

   b. Return Fan in Hand: Commanded off, but the status is on.

c. Return Fan VFD Fault.

L. Return Fan Speed Control: The BAS shall modulate the return fan speed by the greater of the two following control loops:

1. The supply fan VFD signal shall be utilized for the primary control loop to determine the cfm setpoint of the return fans sensed by the VFD speed signal. The cfm setpoint shall be used to establish a linear relationship from the signal established during the air balance based on the maximum measured supply cfm less any cfm required to maintain the building at +0.05" wc, and.

2. The secondary control loop shall be based on maintaining a positive pressure in the exhaust air plenum by modulating the exhaust air dampers to maintain an exhaust plenum pressure of +0.02" wc minimum to 0.07" wc maximum.

3. The fan VFD speed(s) shall not drop below 15 Hz, or as recommended by manufacturer.

4. Alarms shall be provided as follows:

a. High Return Air Static Pressure: If the return air static pressure is 1.0 inches H2O greater than setpoint.

b. Low Return Air Static Pressure: If the return air static pressure drops to 0.25 inches H2O.

M. Supply Air Temperature Setpoint - Optimized: The BAS shall monitor the supply air temperature and shall maintain a supply air temperature setpoint reset based on zone cooling requirements.

1. The supply air temperature setpoint shall be reset for cooling based on zone cooling requirements as follows:

a. The initial supply air temperature setpoint shall be 55°F.

b. As cooling demand increases, the setpoint shall incrementally reset down to a minimum of 53°F.

c. As cooling demand decreases, the setpoint shall incrementally reset up to a maximum of 72°F.

N. Cooling Stages:

1. The BAS shall measure the supply air temperature and stage the cooling to maintain the cooling setpoint. To prevent short cycling, there shall be a user definable delay between stages, and each stage shall have a user definable minimum runtime.

2. The cooling shall be enabled whenever:

a. The economizer mode (if present) is disabled and the outside air temperature is not sufficient to meet the cooling demands.

b. And, the supply fan status is on.

c. Alarms shall be provided as follows:

d. High Supply Air Temperature: If the supply air temperature is 5°F greater than setpoint.

e. Low Supply Air Temperature: If the supply air temperature is below 40°F.

O. Heating Stages:

1. The BAS shall measure the supply air temperature and stage the heating to maintain the cooling setpoint.

2. The heating shall be enabled whenever:

a. The supply fan status is on.

b. And, the cooling or economizer is not active.

c. And, the supply air temperature is below cooling setpoint

3. The heating shall stage on whenever:

a. Supply air temperature drops to 35°F.

b. Or, the freezestat (if present) is enabled and heating coil is upstream of evaporate coil.

4. Alarms shall be provided as follows:

a. Low Supply Air Temperature: If the supply air temperature is 5°F less than set-point.

P. Supplemental Electric Heating Stage: Used for defrost mode, backup heat & dehumidification mode.

Q. Air Economizer: The BAS shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position per design and as determined by the test and balance contractor whenever occupied.

1. The economizer shall be enabled whenever:

a. Outside air temperature is less than 65°F.

b. And, the outside air temperature is less than the return air temperature.

c. And, the supply fan status is on.

2. The economizer shall close whenever:

   a. Mixed air temperature drops below the supply air temperature required to meet the cooling demand.

   b. Or, the freezestat (if present) is energized.

   c. Or, on loss of supply fan status.

R. The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If optimal start up is available the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed position.

S. Minimum Outside Air Ventilation - Carbon Dioxide (CO2) Control: When in the occupied mode, the BAS shall monitor the zone CO2 levels served by this air handling unit. There are (2) sensors to be averaged by the BAS system for this reading. The unit shall modulate the outside air damper(s) open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoint of not more than 800ppm above ambient outside air CO2 concentration.

1. Alarms shall be provided as follows:

   a. High Zone Carbon Dioxide Concentration: If the zone CO2 concentration is greater than 1500 ppm.

   b. Zone Unoccupied Override: A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

T. Pre-occupancy: The air handler shall be energized a minimum of one half hour prior to scheduled occupied period to circulate design minimum ventilation air throughout the building. Temperature control may continue to function per the un-occupied schedule.

U. Prefilter Differential Pressure Monitor: The BAS shall monitor the differential pressure across the prefilter.

1. Alarms shall be provided as follows:

   a. Prefilter Change Required: Prefilter differential pressure exceeds a user definable limit initially set to 0.5” wg above clean filter differential static pressure.

V. Final Filter Differential Pressure Monitor: The BAS shall monitor the differential pressure across the final filter.

1. Alarms shall be provided as follows:

   a. Final Filter Change Required: Final filter differential pressure exceeds a user definable limit initially set to 1.0” wg above the clean filter differential static pressure.

W. Mixed Air Temperature: The BAS shall monitor the mixed air temperature and use as required for economizer control or preheating control.

1. Alarms shall be provided as follows:

a. High Mixed Air Temperature: If the mixed air temperature is greater than 90°F.

b. Low Mixed Air Temperature: If the mixed air temperature is less than 40°F.

X. Room Humidity: The BAS shall monitor the room humidity and use as required for economizer control & dehumidification control.

1. Alarms shall be provided as follows:

a. High Room Air Humidity: If the room air humidity is greater than 70% RH.

b. Low Return Air Humidity: If the room air humidity is less than 35% RH.

Y. Return Air Temperature: The BAS shall monitor the return air temperature and use as required for setpoint control or economizer control (if present).

1. Alarms shall be provided as follows:

a. High Return Air Temperature: If the return air temperature is greater than 90°F.

b. Low Return Air Temperature: If the return air temperature is less than 45°F.

Z. Supply Air Temperature: The BAS shall monitor the supply air temperature.

1. Alarms shall be provided as follows:

a. High Supply Air Temperature: If the supply air temperature is greater than 120°F.

b. Low Supply Air Temperature: If the supply air temperature is less than 45°F.

3.5 TYPICAL STAND ALONE EXHAUST FAN - ON/OFF

A. Run Conditions - Interlocked: The fan(s) shall be interlocked to run per building schedule and shutdown on safeties.

B. Control – BMS to turn fan system on/off. Associated motorized damper shall open prior to fan starting and close after fan shuts down.

C. Fan Status: The controller shall monitor the fan status.

1. Alarms shall be provided as follows:

a. Damper Failure: Command open but status is closed

b. Damper in Hand: Command off, but the status is open

c. Fan Failure: Commanded on, but the status is off.

d. Fan in Hand: Commanded off, but the status is on.

3.6 VARIABLE FREQUENCY DRIVE INTERFACE

A. Variable Frequency Drive (VFD) Interface Monitor: Current VFD status and operating conditions shall be monitored through its communications interface port. The interface shall monitor and trend the points as shown on the Points List.

3.7 ELECTRIC METER

A. Building Electric Meter and all Electric Sub-metering (see electrical single line diagram for meter counts): The controller shall monitor the electric meter for electric consumption on a continual basis. These values shall be made available to the system at all times. The BMS shall graphically display each meter with a building system tag.

1. Alarm shall be generated as follows: Meter Failure: Sensor reading indicates a loss of pulse output from the electric meter.

B. Peak Demand History: The controller shall monitor and record the peak (high and low) demand readings from the electric meter. Peak readings shall be recorded on a daily, month-to-date, and year-to-date basis.

C. Usage History: The controller shall monitor and record electric meter readings so as to provide a power consumption history. Usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

3.8 OUTSIDE AIR CONDITIONS

A. Outside Air Conditions: The controller shall monitor the outside air temperature and humidity and calculate the outside air enthalpy on a continual basis. These values shall be made available to the system at all times.

1. Alarm shall be generated as follows:

B. Sensor Failure: Sensor reading indicates shorted or disconnected sensor. In the event of a sensor failure, an alternate outside air conditions sensor shall be made available to the system without interruption in sensor readings.

1. If an OA Temp Sensor cannot be read, a default value of 65^0F will be used.

2. If an OA Humidity Sensor cannot be read, a default value of 50 % will be used.

C. Outside Air Temperature History: The controller shall monitor and record the high and low temperature readings for the outside air. These readings shall be recorded on a daily, month-to-date, and year-to-date basis.

3.9 WATER FLOW METER

A. Water Meter: The controller shall monitor the water meter for water consumption on a continual basis. These values shall be made available to the system at all times.

1. Alarm shall be generated as follows: Meter Failure: Sensor reading indicates a loss of pulse output from the water meter.

B. Peak Demand History: The controller shall monitor and record the peak (high and low) demand readings from the water meter. These readings shall be recorded on a daily, month-to-date, and year-to-date basis.

C. Usage History: The controller shall monitor and record water meter readings so as to provide a water consumption history. Usage readings shall be recorded on a daily, month-to-date, and year-to-date basis.

3.10 FIRE ALARM INTEGRATION

A. The BMS shall annunciate with the fire alarm system by receiving a signal that indicates there is an active fire alarm in progress. The HVAC systems serving the building shall safely shut down except for systems serving process loads in telecom, electrical and elevator control rooms – those systems shall continue to operate. All HVAC systems shall automatically start back up 10 minutes after the fire alarm has been disabled.

3.11 LIGHTING CONTROL SYSTEM

A. Receive occupied/unoccupied status from div 26 occupancy sensors for each room. If any room in a zone is occupied, the zone will be considered occupied. Coordinate with div 26 on best method to accomplish this whether direct bacNET signal or control wiring is required to auxiliary connection on sensor.

END OF SECTION

REFRIGERANT PIPING SYSTEMS

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. Includes, but not limited to:

1. Furnish and install piping and piping specialties for refrigeration systems serving split system air conditioning units.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic Materials and Methods

B. Section 230700: Mechanical Insulation

C. Section 238126: Split Air Conditioning Units

D. Section 238145: Split Heat Pump Units

E. Division 26: Electrical

1.4 QUALITY ASSURANCE

A. Qualifications: A refrigeration contractor licensed by the State shall install refrigerant piping.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

A. Meet requirements of ASTM B 280-88, "Specification for Seamless Copper Tube for Air Conditioning & Refrigeration Field Service", hard drawn straight lengths. Reflok aluminum piping and mechanical fittings may be considered with prior approval.

B. Do not use pre-charged/pre-insulated refrigerant lines more than 50 feet in length.

1. Gel Copper Pre-Insulated Copper Rolls or equiv.

2.2 REFRIGERANT FITTINGS

A. Wrought copper with long radius elbows.

B. Approved Manufacturers:

1. Mueller Streamline

2. Nibco, Inc.

3. Grinnell

4. Elkhart Products Corp.

5. PDM

2.3 SUCTION LINE TRAPS

A. Manufactured standard one-piece traps.

2.4 CONNECTION MATERIAL

A. Brazing Rods:

1. Copper to Copper Connections:

a. AWS Classification BCuP-4 Copper Phosphorus (6% silver).

b. AWS Classification BCuP-5 Copper Phosphorus (15% silver).

2. Copper to Brass or Copper to Steel Connections

a. AWS Classification BAg-5 Silver (45% silver)

3. Do not use rods containing Cadmium.

2.5 FLUX

A. Approved Manufacturers

1. "Stay-Silv white brazing flux" by J.W. Harris Co.

2. High quality silver solder flux by Handy & Harmon.

2.6 EXPANSION VALVES

A. For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.

B. Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.

C. Approved Manufacturers:

1. Alco

2. Henry

3. Mueller

4. Parker

5. Singer

6. Sporlan

2.7 FILTER-DRIER

A. On lines 3/4 inch outside diameter and larger, filter-drier shall be replaceable core type with non-ferrous casing and Schraeder type valve.

B. On lines smaller than 3/4 inch outside diameter, filter-drier shall be sealed type using flared copper fittings.

C. Size shall be full line size.

D. Approved Manufacturers:

1. Alco

2. Mueller

3. Parker

4. Sporlan

5. Virginia

2.8 SIGHT GLASS

A. Combination moisture and liquid indicator with protection cap.

B. Sign glass shall be full line size.

C. Sight glass connections shall be solid copper or brass, no copper-coated steel sight glasses allowed.

D. Approved Manufacturers:

1. Alco

2. Asco

3. Mueller

4. Parker

5. Sporlan

2.9 MANUAL REFRIGERANT SHUT-OFF VALVE

A. Ball valves designed for refrigeration service and full line size.

B. Valve shall have cap seals.

C. Valves with hand wheels are not acceptable.

D. Provide service valve on each liquid and suction line at compressor.

E. If service valves come as integral part of condensing unit, additional service valves shall not be required.

F. Approved Manufacturers:

1. CoBraCo (Apollo)

2. Henry

3. Mueller

4. Superior

5. Virginia

2.10 FLEXIBLE CONNECTORS

A. Provide each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons.

B. Anchor pipe near each flexible connector.

C. Connectors shall be for refrigerant service with bronze seamless corrugated hose and bronze braiding.

D. Approved Manufacturers:

1. Anaconda "Vibration Eliminators" by Anamet

2. Vibration Absorber Model VAF by Packless Industries

3. Vibration Absorbers by Superior Valve Co.

4. Style "BF" Spring-flex refrigerant connectors by Vibration Mountings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Slope suction lines down toward compressor or one inch/10 feet. Locate traps at vertical rises against flow in suction lines.

B. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary.

1. No soft solder (tin, lead, antimony) connections will be allowed in system.

2. Braze valve, sight glass, and flexible connections.

3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.

C. Insulate all suction and hot gas lines. Insulate liquid lines where pipe may be in close contact to humans.

3.2 FIELD QUALITY CONTROL

A. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping system. Positive pressure test will not suffice for procedure outlined below:

1. Draw vacuum on each entire system with vacuum pump to 200 microns using vacuum gauge calibrated in microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum. Isolate compressor from system piping using shut-off valves prior to pulling vacuum.

2. Break vacuum with refrigerant to be used and re-establish vacuum test. Vacuum shall hold for 24 hours at 200 microns without compressor running.

3. Conduct test at 70°F ambient temperature minimum.

4. Do not use systems until tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.

5. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.

6. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlets at same end of coil

END OF SECTION

AIR DISTRIBUTION

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this Section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Ductwork - Rigid, Flexible and Fabric
2. Ductwork Specialties
3. Flexible Connections
4. Sealants, Adhesives and Tapes
5. Flashings
6. Bird Screens
7. Duct Access Panels and Doors
8. Control Dampers
9. Backdraft Dampers
10. Louvers
11. Diffusers, Grilles, and Registers
12. Fire and Smoke Dampers
13. Sound Traps
14. Variable Air Volume (VAV) Terminal Units
15. Elevator Shaft Vents

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic Materials and Methods

B. Section 230593: Testing, Adjusting and Balancing

C. Section 230700: Mechanical Insulation

D. Section 230900: Controls and Instrumentation

E. Division 26: Electrical

1.4 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:

1. ARI 885-98 “Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminal and Air Outlets.”

2. AMCA-210 - Laboratory Methods of Testing Fans for Rating Purposes.

3. ANSI S1.23 - Designation of Sound Power Emitted by Machinery and Equipment.

4. ASC-A7001 - Standard for Duct Sealants.

5. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip. Type 304 or 304 stainless steel.

6. ASTM A525 - Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) Hot-Dip Process. G90 zinc-coated.

7. ASTM A527/A527M - Standard Specification for Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.

8. TIMA AAC-101 - Standard for fiberglass duct liner with erosion proof facing.

9. UL 181 - Factory-Made Air Ducts and Connections, Class 1.

B. Conform to NFPA 90A "Standards for the Installation of Air Conditioning and Ventilating Systems".

C. Provide and construct ductwork systems in conformance with the latest editions of the following documents:

1. SMACNA "HVAC Duct Construction Standards-Metal and Flexible - 2005"

2. SMACNA "Accepted Industry Practice for Industrial Duct Construction" for duct pressures above +5" W.G. positive pressure or below -5" W.G. negative pressure. Where differences exist between SMACNA and the prevailing building code, the gauge or construction method of the submitted ductwork shall be the more stringent of the two standards

3. ASHRAE Systems and Equipment Handbook "Duct Construction" chapter

4. ASHRAE Fundamentals Handbook "Duct Design" chapter

D. Alternatives: The SMACNA standards and publications referenced in this Section of the specifications establish ductwork construction requirements.

1. Alternatives to these standards and publications may be submitted. Approval will be based on demonstration that such alternatives are equivalent and satisfy the functional requirements described in the referenced standards.

2. Such demonstration shall include evidence that the alternatives proposed were tested in accordance with SMACNA procedures and with test results certified by an independent testing laboratory.

E. All ductwork and equipment shall be seismically supported and braced per the SMACNA "Seismic Restraint Manual: Guidelines for Mechanical Systems".

F. Flame/Smoke Rating: All materials, including sealants and adhesives, exposed within plenum shall have a flame-spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.

1.5 SUBMITTALS

A. Prior to construction, submit for approval on all materials and equipment:

1. Ductwork - Rigid, Flexible and Fabric

2. Ductwork Specialties

3. Flexible Connections

4. Sealants, Adhesives and Tapes

5. Flashings

6. Bird Screens

7. Duct Access Panels and Doors

8. Backdraft Dampers

9. Control Dampers

10. Diffusers, Grilles, and Registers

11. Fire and Smoke Dampers - Schedule of selected dampers must include the location, nominal size, free area velocity, and static pressure drop at free area velocity for each damper.

12. Sound Traps

13. SMACNA "HVAC Duct Construction Standards - Metal and Flexible"

B. Product Data:
1. Catalog cuts and installation instructions for all products specified.

2. Performance Data: For each size air terminal scheduled, submit the following:

a. Inlet static pressure in [inches w.g. Pa (above barometric pressure).

b. Maximum and minimum airflow in cfm

c. Throw at maximum airflow (and 25 percent of airflow) for terminal velocities of 50 and 100 fpm.

d. Noise Criteria (NC) curve at maximum air terminal airflow rating with blades in full-open and closed positions.

C. Shop Drawings: Provide shop drawings of sheet metal ductwork and plenums as follows:

1. Draw to a scale not less than ⅛" to one foot, with sheet sizes equal to Contract Drawings.

2. Show duct sizes, where possible use even duct sizes.

3. Show fitting details.

4. Show coordination with lighting fixtures, fire dampers, smoke dampers, piping, diffusers, grilles, registers, fans, major electrical runs, cable trays and bus ducts.

D. Shop Drawings: Provide shop drawings for field erected mechanical equipment:

1. Draw to a scale of ½” to one foot, with sheet sizes equal to Contract Drawings.

2. Show plan, sections, elevations and details of all joints and enclosures.

3. Detail access doors and hardware.

4. Detail coil, damper, humidifier, filter and fan installations.

5. Show access space for electrical components that are part of the equipment provided and/or installed such as power and control panels on humidifiers. This shall be coordinated with Division 26 and NEC.

E. Certifications: Provide a duct schedule, certified by an officer of the sheet metal fabrication subcontractor, that the ductwork conforms to SMACNA standards, and for each sheet metal system furnished on the project include:

1. System name.

2. Duct material.

3. Duct gauge.

4. SMACNA rectangular reinforcement number.

5. SMACNA intermediate reinforcement number.

6. SMACNA transverse reinforcement number.

7. Rod diameter and type.

8. Sealant type.

9. Attachment method.

10. Duct system design pressure.

F. Construction IAQ Management Plan: Collaborate with the general contractor to submit and implement an IAQ Management Plan for the construction process meeting the requirements of the SMACNA IAQ Guidelines. This plan should address the protection of the ventilation system components during construction and cleanup of contaminated components after construction is complete. SMACNA IAQ Guideline recommends control measures in five areas. The IAQ Management Plan should address how compliance has been achieved in these required five areas as follows:

1. HVAC Protection

   a. Shutdown of return side of existing HVAC system in areas affected by heavy construction.

   b. Provision of temporary filters if existing or new systems must remain operational during construction.

   c. Dampering of supply and returns and sealing of openings in areas subject to construction dust.

2. Source Control

   a. How will reduction of contaminants be reduced at the source?

   b. What steps will be taken to employ low emitting products and sealants.

   c. How will air handling equipment be cycled off when not needed?

3. Pathway Interruption

   a. Describe how the construction space will be ventilated as required to dilute contaminants.

   b. Describe how occupied spaces adjacent to construction areas will be kept at positive pressure relative to spaces under construction.

4. Housekeeping: Describe how the following housekeeping objectives will be implemented:

   a. Reduction of dust generated by work will be suppressed.

   b. Maintaining a frequent cleaning frequency for dust and particulates.

   c. Remove spills or excess applications of solvent-containing products as soon as possible.

   d. Remove accumulated water and keep work areas as dry as possible.

   e. Protect insulation materials from exposure to moisture.

5. Scheduling: Describe how overlap of construction activity and ongoing building occupancy activities will be minimized.

G. Field Manual: Submit one copy of the SMACNA "HVAC Duct Construction Standards - Metal and Flexible". Maintain a second copy on the project site.

H. Any ductwork installed without prior approval by the specifier, shall be replaced at the expense of the contractor.

I. The contractor must comply with the enclosed specification in its entirety. If on inspections, the specifier finds changes have been made without prior approval, the contractor will make the applicable changes to comply with this specification, at the contractor’s expense.

J. At the discretion of the specifier, sheet metal gauges, and reinforcing may be checked at various times to verify all duct construction is in compliance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect products against dirt, water, chemical, and mechanical damage. Do not install damaged components. Remove damaged products from project site.

PART 2 - PRODUCTS

2.1 DUCTWORK

A. Construct all ducts and plenum of gauges, and with joints, bracing, reinforcing, and other construction details in accordance with the latest construction standards previously listed. Metals shall be manufactured by United States Steel, Kaiser, Rolok or equal.

B. Duct dimensions indicated on drawings are net, inside, clear dimensions. For internally lined ducts, add lining thickness to determine metal duct dimensions.

C. Ducts shall be constructed of material gauges and reinforcement per SMACNA pressurization classifications to meet 150% of the pressure requirements for external static pressure scheduled on drawings for the fans serving each system. Where differences exist between SMACNA and the prevailing building code, the gauge or construction method of the submitted ductwork shall be the more stringent of the two standards. See also Part III Execution for matrix of materials and pressure requirements.

2.2 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 A653/A653M.

1. Galvanized Coating Designation: G90 (Z275)

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.

2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D3363.

4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

5. Shop-Applied Coating Color: White.

6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

D. Reinforcement Shapes and Plates: ASTM A36/A36M, 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.

E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 DUCTWORK FABRICATION

A. Joints – Sealing

1. Duct tape is not allowed. Rolled elastomeric duct sealants are not allowed.

2. Solvent-based and oil-based sealants are not allowed indoors.

3. Seal all transverse joints - this includes mechanical joints similar to Ductmate on all supply, return, exhaust and outside air intake ducts.

4. All sealant systems for outdoor application to be suitable for use in exposure to water.

5. All sealant systems for indoor application to be meet VOC limits as specified in South Coast Air Quality Management District (SCAQMD) Rule #1168 limiting VOC's to 80 gram/Liter for ductliner adhesives and 250 grams/Liter for duct sealants.

6. Manufacturers: Tremco, Dure Dyne, Hardcast, Ductmate, Mon-Eco Industries, McGill AirSeal LLC, or equal, as recommended for ductwork application.

7. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, suitable for high velocity and high pressure applications, UL 181B-M listed, UL 723 classified, and complying with NFPA requirements for Class 1 ducts.

   a. Outdoor Application: Not permitted where subject to moisture exposure.

   b. Indoor Application: Hardcast Iron Grip, Ductmate PROseal, Mon-Eco EZ Seal 44-44, or equal.

8. Two-Part Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermally with tape to form hard, durable airtight seal. Hardcast Two Part II, McGill Uni-Cast, or equal.

B. Joints - Rectangular Ducts

1. Slip drive joints, standard seams, flanges or welding as required by SMACNA HVAC Duct Construction Standards for system static pressure. Ductmate, MEZ Industries, or equal are acceptable joint methods, but must be sealed as described previously. Transverse joints shall be constructed per Figure 1-4 for types T-8 through T-25. T-1 and T-5 slip joints are NOT allowed. Joint T-2, T-3, T-6 and T-7 reinforced slip joints are allowed below 2" static pressures.

C. Joints - Round

1. Exposed Ductwork: Slip drive and sheet metal screws.

2. Concealed Ductwork: Sheet metal screws.

D. Elbows

1. Construct long radius elbows with centerline not less than 1.5 times the duct width. Shorter radius elbows may be used where required to fit in restricted spaces, or as shown. Provide single thickness turning vanes on all short rectangular radius elbows less than 25" wide. Provide double thickness turning vanes for short rectangular radius elbows 25" wide and greater. Number of vanes per SMACNA. Elbows with square throat and radius heel are NOT allowed.

E. Transitions

1. Construct transitions with minimum slope of 1 to 5 ratio and in conformance to SMACNA.

F. Branch Connections

1. Provide 45° entry boots or radius taps for rectangular duct take-offs and conical or bellmouth taps for round duct take-offs. Straight 90° taps are not allowed, except where round take-off duct size equals round branch duct size. Provide volume dampers at take-offs for balancing if not specifically noted as provided at outlet or inlet. Provide insulation guards at transitions to lined ductwork.

2.4 RECTANGULAR DUCTWORK

A. Construct rectangular ductwork to meet all functional criteria defined in Section VII, of the SMACNA “HVAC Duct Construction Standards Metal and Flexible” 1995 Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, code requirements. Ductwork shall be constructed of galvanized steel. Diagonally cross break all panels on ducts 30 inches wide and larger, or bead using automatic bead machine with beads at 12 inches on center or less. All connections shall utilize 45° boot take-offs. Bullhead tees and straight taps are not permitted.

2.5 ROUND AND OVAL DUCTWORK

A. Round and oval ductwork shall be constructed to SMACNA round ductwork requirements of galvanized sheet steel. 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. Longitudinal seams shall be spiral lock seams or continuous welded. Flat oval shall be utilized in space-restricted areas. Elbows shall be 5-piece mitered and welded. All elbows shall be long radius type with centerline radius to duct diameter of 1.5, exceptions will only be allowed at restricted space locations.

B. Round or oval duct and fitting manufacturers:

1. McGill Airflow Corporation

2. Lindab

3. Semco

4. Sheet Metal Connectors

5. Spiral Manufacturing

6. Or equal.

C. 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: 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." All transverse joints to be externally sealed at all joints.

1. Exception: internal manufactured single or dual EPDM rubber gasket fittings do not require external sealant.

2. Transverse joints in ducts larger than 50” diameter require flanged joints.

3. Lap or snap lock seams are not permitted for round ductwork of any size.

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.” All longitudinal joints shall be sealed air tight with sealant or continuous welding.

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, "45 Degree Tees and Laterals”, and Figure 3-6, "Conical Tees” and “45 Degree Boot 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.”

1. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted.

2.6 FLEXIBLE DUCTWORK

A. Flexible one-inch thick insulated round ductwork may be utilized where shown on the Drawings and at the last five (5’) feet to each air outlet and inlet, unless shown otherwise on the plans. Maximum of only one 90° bend in any length. No intermediate joints are allowed. Connect each end with stainless steel screw operated drawbands. Support duct to maintain smooth shape without sagging. All connections shall utilize welded conical tees, aluminum conical fitting with

damper by Flexmaster #CBD, or 45° boot take-offs by Flexmaster #STOD. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted.

B. Flexible ductwork for low pressure systems with positive static pressure at or below 2" w.g. positive pressure shall be a trilaminate of aluminized foil, fiberglass insulation, and aluminized polyester, mechanically locked to galvanized steel helix without adhesives, exterior 1" fiberglass insulation and fire retardant plastic outer jacket. Flexmaster #Type 5B, Thermoflex Model MKE or approved equal.

C. Flexible ductwork for medium and high pressure systems with static pressures above 2" w.g. through 10" w.g. positive pressure shall be a heavy coated fiberglass cloth fabric mechanically locked to galvanized steel helix without adhesives, exterior 1" fiberglass insulation and fire retardant plastic outer jacket. Flexmaster #Type 4B, Thermoflex Model MKC or approved equal.

2.7 ACOUSTICAL DUCT LINER

A. Acoustic Duct Lining shall be installed where shown on the drawings and as specified for low velocity supply, return and exhaust ductwork. Liner is to be utilized to line vertical supply duct risers, mechanical shafts conveying return air, terminal box discharge plenums, and other horizontal duct runs where shown on drawings. Dimensions of lined ducts given on the drawings indicate the inside dimensions of duct after the lining has been installed. Black-coated (vinyl, acrylic or neoprene) duct lining shall be adhered by 100% covering of a fire retardant adhesive (3M EC-1128, Benjamin-Foster 85-20, or equal). When width of duct exceeds 12" and also on sides when height exceeds 24", use non-ferrous mechanical fasteners such as welded pins and speed clips, 12" on center maximum lateral spacing and 18" on center maximum longitudinal spacing. Start fastening within 3" of upstream transverse edge of the liner and within 3" of the longitudinal joint. Mechanical fasteners shall not pierce the duct walls. The pins shall be cut off flush, washers shall be used and installation made so that no gaps or loose edges occur in the insulation. Apply a brushcoat of Benjamin-Foster 30-36 to washers, extending onto lining surface a minimum of 2". Top pieces shall be supported by the side pieces. Provide insulated build out frames for attaching dampers at running vanes where required.

B. All transverse and longitudinal abutting edges of duct lining shall be sealed and lapped 3" with a heavy coat of Foster 30-36, in accordance with the manufacturer's recommendations. All exposed edges shall be installed with sheet metal nosings. At all openings in the ductwork there shall be a galvanized metal flange, equal in depth to adjacent lining and having a 1½" lip to hold lining in place. All bolt holes shall be sealed airtight.

C. Internal Duct lining shall be installed in complete accordance with the Sheet Metal and Air-Conditioning Contractors National Association (SMACNA) Duct Lining Application Standard. Mechanical fasteners shall conform to Mechanical Fastener Standard MF-1 from SMACNA. Adhesive shall be water-based and conform to Adhesive and Sealant Council Standards for Adhesives for Duct Liner ASC-A-7001C.

2.8 PLENUMS AND EQUIPMENT CASINGS

A. Construct casings and plenums in conformance with SMACNA.

B. Minimum Pressure Class: Unless otherwise indicated construct plenums and casings to withstand either a negative or positive static pressure of 4" W.G.

C. Single-Wall: Provide single-wall, casings and plenums where indicated on the drawings.

1. Construct in accordance with SMACNA Standards.

2. Use steel-angle-reinforced standing-seam construction.

3. Locate intermediate bracing angles bolted to the casing 24 inches on centers.

4. Construct for static pressure indicated or for the maximum fan static pressure whichever is less.

5. Bolt to 3" high concrete pads using 1½" x 1½" x ¼" thick galvanized steel structural sections.

D. Double-Wall: Provide where indicated on the drawings, constructed as follows:

1. Provide 4" thick prefabricated double wall insulated metal panel assemblies, with 16MS gauge aluminum or 18 gauge minimum galvanized steel outer sheets.

2. Provide 22 gauge Type 304 stainless steel inner sheets.

3. Casings shall be fully metal enclosed, insulated with 4" thick rigid fiberglass insulation and conforming to NFPA 90A, with maximum flame spread of 25 and maximum smoke developed of 50.

4. Field or factory fabricate to size and configuration indicated on the drawings, using field verified dimensions.

5. Provide coordinated shop drawings.

6. Reinforce spans 10' or greater with structural steel sections to yield maximum deflection ¼" at minus 10" or plus 10" W.G. static pressure.

7. Provide openings and doors, all factory framed, and reinforced with 304 stainless steel structural sections.

8. Construct doors of same material as casings, of sizes and locations indicated on the drawings but not smaller than 18" by 54", and conforming to SMACNA.

9. Provide doors, hinges and hardware factory fabricated and mounted.

10. Door swings shall open against air pressure, with door latches operable from either side.

11. Provide door seals with neoprene gaskets, which have an airtight seal.

12. Provide each door with a 10" by 10" wire reinforced double pane window.

13. Bolt base channel to 3" high concrete pads.

2.9 HDPE DUCTWORK FOR UNDERGROUND APPLICATION

A. Code Compliance: All duct and fittings shall be designed and constructed to meet the applicable requirements of the mechanical codes for direct burial application. These requirements include:

1. Ducts to be approved for underground installation.
2. Plastic and HDPE duct and fittings described below may be utilized in underground installations only. The maximum design temperature for systems utilizing plastic duct and fitting shall be 150°F and -10" to 52" w.g.

B. Underground ductwork, including fittings, shall be constructed of HPDE manufactured by Blue Duct All ductwork and fittings shall include labels certifying this and shall be installed in strict accordance with the manufacturer's instructions.

2.10 DUCTWORK SPECIALTIES

A. General: Where specifically called for, materials for use in fabricating ductwork specialties shall be identical to that used to fabricate ductwork. See drawings and Part 3, Execution for schedule.

B. Volume and Splitter Dampers: Galvanized sheet metal blade and frame with Ventfabrics Inc., Ventlok operating hardware. For accessible dampers, provide #641 self -locking dial regulators and #644 self-locking dial regulators for insulated ductwork, #637 square end bearing, and #635 spring end bearing, as applicable. For inaccessible dampers, provide #666 or #677 concealed locking damper regulator with bearings as above. For static pressures above 3" W.G., provide #640 HiVel dial regulator and #609 HiVel end bearing for accessible dampers. Regulators shall extend to and through ceiling with neatly installed hardware at the finished ceiling. For inaccessible dampers requiring adjustment through diffusers use Young Regulator, Bowden cable control system.

C. Multi-louver Volume Dampers: 16 gauge galvanized steel frame. Opposed, 6" wide, 16 gauge galvanized steel blades. Concealed linkage in frame. Ruskin #CD35/OBD or equal.

D. Flexible Connections: Provide flexible connectors at the discharge and inlet of fans, air handlers, rotating mechanical equipment, and where shown on the Drawings for proper vibration isolation. Neoprene impregnated glass cloth with 24 gauge galvanized metal frame. Neoprene-only connectors are not allowed. Minimum dimensions - 3" metal, 3" fabric, 3" metal. Ventfabrics #Ventglas or approved equal by Duro Dyne, Q Industries, consolidated Kinetics, Ductmate Proflex or Elgen.

E. Ducts through roof shall be 16 gauge (or minimum of 2 gauges heavier than attaching ductwork), flashed and counterflashed, and provided with storm collars to secure a watertight construction.

F. Bird Screens: 14 gauge, ½", galvanized wire mesh, set in a galvanized steel frame, screw set.

2.11 DUCT ACCESS PANELS AND DOORS

A. In sheet metal work, hollow core double construction of same or heavier gauge material as duct in which installed. Use no door smaller than 12" by 12" for simple manual access or smaller than 24" by 24" where personnel must pass through infrequently. Use 24" by 60" minimum for filters and more frequent maintenance. Use Ventlok or approved hinges and latches on all doors; 100 Series hinges and latches on low pressure system doors up to 18 " maximum dimension, 200 Series on larger low pressure system doors and 333 Series on high pressure systems. Construct doors up to 18 " maximum dimension with one inch overlap fit and gasket with ¾" by ⅛" sponge rubber, fit larger doors against 1½" by ⅛" flat stock or angle frame and gasket with ¾" by ⅛" sponge rubber or felt. Door swing to be opposite airflow. CESCO, Vent Products, Air Balance, Ductmate Sandwich or equal. Access doors smaller than 12" x 12" can be used for visual inspection of dampers, etc. on small ductwork less than 12" wide but must be of maximum size that will fit on duct with 6" x 6" as minimum size. All access doors smaller than 12" x 12" must be approved by Engineer for the specific application prior to ordering.

2.12 CONTROL DAMPERS

A. General: Low leakage dampers are to have a maximum leakage rate of 3 cfm/ft^2 at 1.0 in w.g. pressure difference when tested to AMCA Standard 500.

B. Damper Type One: Airfoil Low Leakage Dampers

1. Application: Commercial supply, return, and general exhaust air systems up to 3,000 fpm velocity.

2. Frames to be 5" x 1"x 16 gauge steel channel

3. Blades to be 6" wide, 14 gauge galvanized steel design.

4. Axles to be ½" diameter plated steel.

5. Bearings to be stainless steel sleeve type pressed into frame.

6. Linkage to be concealed in frame

7. Crank lever for operator to be provided.

8. Provide with mill finish on blades and frame.

9. Silicone rubber blade seals.

10. Flexible metal jamb seals.

11. Maximum temperature rating to be 300°F.

12. Edit options as applicable Required Options:

a. Damper position indicator switch

13. Manufacturer: Ruskin #CD60, Swartout, NCA PBD/OPD-AF-101, American Warming, Air Balance, Greenheck or approved equal.

C. Damper Type Three: Heavy Duty

1. Application: Velocity over 3,000 fpm and fan outlet damper.

2. Frames to be 10" x 2" x 12 gauge steel channel.

3. Blades to be 7¾" wide, 0.080 thick extruded aluminum airfoil design.

4. Axles to be ¾" diameter plated steel.

5. Bearings to be stainless steel sleeve type pressed into frame.

6. Linkage to be out of airstream with 10 gauge galvanized steel clevis type arms on 7/8" diameter brass trunnions at 3" radius. Tie bar to be ⅜" diameter plated steel.

7. Crank lever for operator to be provided.

8. Provide with mill finish on blades and frame.

9. Maximum temperature rating to be 300°F.

10. Edit options as applicable Options:

a. Silicone rubber blade seals.

b. Flexible stainless steel jamb seals.

c. Bearings with integral shaft seals.

d. Bearings bolted to frame.

e. Bolt holes in frame.

f. Special finishes.

g. Electric or pneumatic operator.

11. Manufacturer: Ruskin #CD102, Swartout, American Warming, Air Balance, Greenheck or approved equal.

D. Damper Type Four: Airfoil Low Leakage Insulated Dampers

1. Application: Natural Ventilation inlets and outlets.

2. Frames to be steel or aluminum channel thermally broken with insulation within frame channels.

3. Blades to be 6" wide, Insulated (½" polystyrene), airfoil shaped, galvanized steel double skin construction of 14 gauge equivalent design.

4. Blade Seals: Extruded silicone rubber with flexible metal compression type jamb mating seal.

5. Axles to be ½" diameter plated steel.(Optional stainless steel)

6. Bearings to be synthetic sleeve type pressed into frame.

7. Linkage to be concealed in frame.

8. Crank lever for operator to be provided.

9. Provide with mill finish on blades and frame.

10. Maximum temperature rating to be 300°F.

11. Edit options as applicable Required Options:

    a. Damper position indicator switch.

12. Manufacturer: Greenheck Model ICD-45, Ruskin #CD40x2, TAMCO Series 9000 BF, or approved equal performance insulating damper.

2.13 BACKDRAFT DAMPERS

A. Damper Types:

1. Heavy Duty Backdraft Dampers: Provide counterweight type complete with frame, end bearings, counterbalance assembly, blades, and linkage. Pressure drop to be no more than 0.24"w.g. at 1000 fpm. Install at outside air intakes, exhaust outlets, and where shown on Drawings. Pacific Air Products #PRD-100AL, Ruskin #CBD2, NCA, or equal by Swartout, American Warming or Vent Products.

2. Nonmetallic Backdraft Damper: Provide complete with 16ga frame, neoprene coated fiberglass blades, galvanized expanded metal grill. Ruskin NMS2.

B. Application Requirements:

1. Generator Discharge Damper: Heavy Duty Backdraft Damper. Size at no more than 1000 fpm velocity.

2. Outside Air Intakes except where a control damper is required – Heavy Duty Backdraft Damper.

2.14 LOUVERS

A. Louvers are to be provided under Division 10. Where louvers are not covered on architectural plans and specifications, contractor is to provide under the following specification:

1. Louvers to be 6" deep, 35° drainable fixed blade design, constructed of galvanized steel or extruded aluminum, or as specified on the plans.

2. Frames to be constructed of 6" deep channel.

3. Provide with ½" x ½" galvanized mesh birdscreen mounted on backside of louver.

4. Finish/color per architect/engineer's review.

5. Manufacturer: American Warming, Industrial Louver, Vent Products, NCA, Swartout, Ruskin ELF6375DX Louvers & Dampers or equal.

2.15 DIFFUSERS, GRILLES AND REGISTERS

A. All diffusers, grilles, and registers shall be selected to provide proper air distribution for the intended occupant application. All supply air devices shall be selected to provide a maximum air velocity of 50 fpm at three feet above the floor, unless otherwise noted. Manufacturer's representative shall carefully review Architectural and Mechanical drawings and ensure diffuser/grille/register selections will provide proper air distribution at NC 25 or less. Manufacturer at no additional expense to the Owner shall replace diffusers, grilles, and registers not providing proper distribution or excessive noise at scheduled airflow.

B. All frames shall be selected to fit the ceiling type. Verify with Architectural Drawing. Each diffuser, grille and register shall be individually capable of balancing via duct mounted balancing dampers or attached opposed blade dampers. Provide unit opposed blade damper where individual duct mounted balancing dampers are not provided.

C. Sizes, capacities and patterns shall be as shown on the Drawings. Manufacturer: Metal Aire, Titus, Krueger, Anemostat, Carnes, Price or Tuttle&Bailey.

2.16 DISPLACEMENT DIFFUSERS

A. Approved Manufacturers:

1. Price

B. Description: Furnish and install Price model series DF1R-HC (WxH) with the configurations and mounting types indicated on the plans and air outlet schedule.

C. Performance: Air shall be delivered to the space at NC-15 noise levels and at maximum air velocity of 30-60 fpm at floor (in cooling) and velocity of 50-75 fpm at floor (in heating). The noise and velocity will be distributed evenly across the diffuser face, in all ducting configurations and without the use of nozzles. Diffuser Manufacturer shall provide sound and pressure drop data derived from tests in accordance with ASHRAE Standard 70-2006.

D. Construction: The diffuser shall be constructed with two separate plenums, one for the heating operation and one for the cooling operation. The cooling section of the heat-cool lay-in Displacement diffuser, model DF1R-HC shall be constructed with an equalization baffle behind the operative diffuser faces for uniform, low velocity, distribution of supply air. Both the equalization baffle and faces shall be securely retained in the diffuser frames. Plastic nozzle arrays or any plastic components are unacceptable. The diffuser frames shall be constructed of steel and shall be welded to ensure rigidity and positioning of the baffle. There shall be no visible fasteners on the front or side panels. The operative face shall be constructed of painted 18 gauge perforated steel, and the frame shall be constructed of 20 gauge steel. The internal baffling elements shall be constructed of Aluminum. The plenum may be satin coat steel. The paint shall be powder coat polyester. Epoxies and their derivatives are unacceptable. Visible non-metallic components are unacceptable. Mounting/Fastening: The diffuser shall be installed within the supplied installation frame. The diffuser shall have no visible fasteners or framing, and shall be held within the supplied installation frame via secure mounting clips.

E. Actuator: Electric Actuator: Thermal Actuator: The diffuser shall use a wax actuator controlling a damper allowing two separate air flow paths. The actuator shall close the heating section when in cooling mode and the supply temperature lowers below 70°F (21°C). The actuator shall close the cooling section when in heating mode and the supply temperature rises above 80°F (27°C). The actuator shall remain accessible from the outside of the diffuser for servicing and shall require no wiring or power by others.

F. Mounting/Fastening: The diffuser shall be installed within the supplied installation frame. The diffuser shall have no visible fasteners or framing, and shall be held within the supplied installation frame via secure mounting clips.

2.17 DUCT SMOKE DETECTORS (DSD)

A. Duct mounted photoelectric smoke detector. One required for each heating or cooling system supplying air in excess of 2,000 cfm, for systems serving more than one occupancy type, and for control of each combination fire/smoke damper when not controlled by Div. 26 area wide detection system. Coordinate with Div 16. Work and electrical installer for power to smoke detector. Detector shall be mounted in the supply air ductwork downstream of the air handler and filters, or upstream of combination dampers. Coordinate with control installer to assure that detector shall shut down the air-moving equipment when smoke is detected and close associated damper actuator(s). Sensor shall be selected to operate with air velocity rating from 100 to 4000 fpm. Provide with metal sampling tube. Provide remote test and reset station at ceiling or as otherwise indicated. Duct smoke detector shall be installed in compliance with the applicable mechanical or building code. Coordinate with Section 230900 and 230593 work. System Sensor #D2 series or approved equal.

B. Additional requirements for duct smoke detectors include requirements per Section 6.4 of NFPA-90A. Provide one duct smoke detector at each story to the connection to a common return and prior to any recirculation or fresh air inlet connection in air return systems having a capacity greater than 15,000 cfm and serving more than one story.

2.18 FIRE AND SMOKE DAMPERS

A. General:

1. Provide UL labeled 3 hour rated fire dampers at 3-hour and greater penetrations.

2. Provide UL labeled 1½ hour rated fire dampers at less than 3-hour penetrations.

3. All dampers to be certified under the latest UL Standard. Certification based on former non-current standards is unacceptable.

4. All damper installations to conform with NFPA 90A and manufacturer's installation instructions. Details on plans are shown for reference only.

5. Install in ducts passing through walls, floors, and ceilings as required by code. Refer to Architectural and Mechanical plans for damper locations.

6. Provide fire and fire/smoke dampers in locations as required by code.

7. Provide sleeves, slip joints, retaining angles, duct access doors, ceiling access panels, etc., as required to check and service the fire dampers. Slip or break away joints are not allowed to be taped or sealed. Access doors shall be tight fitting hinged or sliding and shall have 1" high label reading "FIRE DAMPER" or "FIRE/SMOKE DAMPER".

8. All dampers to be designed for use in dynamic systems.

9. Dampers shall be rated for Leakage Class I. Leakage Class II may be used if damper size is smaller than available Leakage Class I dampers.

10. Dampers shall be certified for use by State and local authorities. Note to Editor-Use ceiling radiation dampers with appropriate diffusers/grilles at one to three hour rated ceiling constructions.

11. Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress doe to twisting, racking, bowing, or other installation error. Do not install actuators in area where moisture can penetrate actuator or where temperature exceeds 120°F.

12. All fire dampers shall be sized to provide equivalent free area through the damper equal to the connecting ductwork, or larger. Upsize fire damper. In no case is the damper pressure drops to exceed 0.25" w.g., but ideally less than 0.10" w.g., as designed for in total system static pressure allowance. See also submittal requirements in Part One of this section.

13. Coordinate with "Security Bars" for installation in detention housing and high security areas. Note to Editor – delete or edit as applicable.

B. Dynamic Fire Dampers: Curtain fire damper constructed and tested in conformance with UL-555C. Fire damper shall have a 165°F fusible link. Fire damper shall be equipped for vertical penetrations with manufacturer supplied sleeve. Installation shall be in accordance with damper

manufacturer's instructions. Curtain damper shall not be located in air stream during system operation, Style B or C. Clear inside opening through fire damper is to match clear inside opening of duct. Fire dampers in lined ducts are to match size of sheet metal duct. Provide duct and ceiling access panel as required. Ruskin#DIBD Series, Pottorff #VFD-10 Series and #VFD-30 Series, or approved equal by Air Balance, Greenheck or CESCO.

C. Combination Fire/Smoke Dampers:

1. General Requirements:

a. Install at rated corridor wall or ceiling penetrations, occupancy separation walls, area separation walls and where shown on plans. Low leakage fire/smoke damper (Leakage Class 1 unless otherwise stated below) with electric actuator. Actuator shall be attached to sleeve outside of air stream. Fire/Smoke damper shall be equipped for vertical wall penetrations with manufacturer supplied sleeve and fail closed on loss of power. Each damper shall be equipped with a controlled 15 second electric heat-actuated release device. This device is to be equipped with a push-button reset. No manual fusible links are permitted. Manufacturer shall provide factory assembled sleeve of 16" minimum length. Installation shall be in accordance with damper manufacturer's instructions. Coordinate power and smoke detector connections with electrical installer. Integral smoke detection and actuating devices may be used if listed and approved for such service. Comply with building code requirements. All combination smoke and fire dampers shall automatically reset from closed to open position upon the reapplication of power to actuators.

b. Actuators: All gear and housing shall be steel. The actuator shall be direct coupled and employ a steel toothed cold-weld clamp for connecting to damper shafts. Aluminum clamps or set-screw attachments are not acceptable. Actuator shall be UL listed and manufactured under ISO 9001 quality control.

1) Actuator shall carry a manufacturer’s 5-year warranty.

2) Actuator shall have microprocessor based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible. Actuator shall be incapable of burning out if stalled before full rotation is reached.

3) Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking, bowing, or other installation error.

4) Actuator shall have UL555S Listing by the damper manufacturer for 350°F and be rated for 20,000 cycles minimum. Actuator shall draw no more than 0.23A at 120V running, or 0.1A holding at 120V (27 VA and 10 VA respectively for 24V power) for 70 in-lb torque.

5) Stall and instantaneous type actuators are not acceptable.

6) Do not install in area where moisture can penetrate damper or actuator nor where actuator temperature exceeds 120°F.

7) All smoke and combination fire and smoke dampers shall be provided with Belimo Aircontrols FSNF24-S actuators, or approved equal.

8) If a Honeywell ML-4115 actuator is submitted as an alternate, it must be provided with a time delay relay to cause the actuator to reset to drive open mode on momentary loss of power for less than 3 seconds.

2. Dampers for Low Velocity Applications (2000 fpm or below):

a. Fire damper shall have 6" wide galvanized steel blades with silicone rubber edge seals.

b. Pressure drop of a typical 24” x 24” size damper shall be no more than 0.05” w.g. at 1000 fpm velocity.

c. Basis of Selection: Ruskin #FSD-37, Ruskin #FSD-60, Ruskin #FSD60FA, Pottorff #FSD-140 Series, Pottorff #FSD-150 Series, or approved equal by Greenheck, CESCO or Air Balance.

3. Dampers for High Velocity Applications (2001 fpm or above):

a. Identical to above except, fire damper shall have 6" wide galvanized steel airfoil blades with silicone rubber edge seals.

b. Pressure drop at 2000 fpm velocity to be no more than 0.08”w.g. for a 24” x 24”size.

c. Basis of selection to be Ruskin FSD 60 with airfoil blade, Pottorf FSD-151, or approved equal air foil damper by Greenheck, CESCO or Air Balance.

4. Dampers for Ceiling Application:

a. Where indicated on plans install at rated corridor ceiling penetrations.

b. Integral smoke detection and actuating devices may be used if listed and approved for such service.

c. Basis of Selection: Ruskin #FSD36-C, Pottorff #FSD-172, CESCO CFSD-21, Greenheck CFSD, or approved equal by Air Balance.

5. Required Options:

a. Provide open or closed indicator option assembly consisting of a single pole and a double throw switch used to indicate damper blade position. Output from switch to position indicator light (LED, provided by Division 26) is by automatic

temperature control contractor. Include switch mounting bracket, crank arm, blade bracket and linkage from blade to the switch.

b. Provide a test module to permit test cycling of the damper/actuator in the field

c. Provide integral smoke detector OR

d. Provide and field install smoke detector. Electrical installer shall wire.

e. For exposed wall applications provide matching wall grille to maintain appearance and fire rating.

f. Temperature limited override: Provide a two temperature electronic high temperature limit. A primary sensor at 165°F can be bypassed by an external electrical signal allowing the damper to reopen and remain open until the temperature reaches the setting of the secondary sensor at 350°F at which point the damper is closed and remains closed. Both sensors are to be equipped with manual resets.

2.19 SOUND TRAPS

A. Sound traps shall be I.A.C., Vibro-Acoustics, Aerosonics, United McGill, Transonics, Ruskin, or approved equivalent. Sound traps shall be sized for a maximum air pressure drop and maximum air velocity as noted on schedule.

B. Materials

1. Outer casings of rectangular silencers shall be made of 22 gauge type #G-90 lock-former-quality galvanized steel.

2. Interior partitions for rectangular silencers shall be not less than 26 gauge type #G-90 galvanized lock-former-quality perforated steel.

3. Filler material shall be as indicated on the Schedules and as appropriate for the application:

a. Standard fill: Filler material shall be inorganic glass fiber of a proper density to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin- and moisture-proof.

b. Encapsulated fill for hospital or clean room applications: Filler material shall be inorganic glass fiber of a proper density to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin- and moisture-proof. Filler material shall be totally encapsulated and sealed with polymeric film of an appropriate thickness. The encapsulated fill material shall be separated from the interior perforated baffles by means of a noncombustible, erosion resistant,

factory-installed, acoustic stand-off. It shall not be acceptable to omit the acoustic stand-off and try to compensate for its absence by means of corrugated baffles.

c. Packless sound traps: No sound absorptive material of any kind is to be used in the silencers. The silencers shall attenuate air/gas transmitted noise solely by virtue of controlled impedance membranes and broadly tuned resonators.

d. "Green" fill alternate: Acoustic fill material shall be 100% environmentally friendly, and constructed of recycled natural fibers. Each fiber shall be treated with an EPA registered fungal inhibitor in order to prevent mold, mildew, fungi, and pest protection. The fill material must not contain any harmful chemicals, irritants, and/or volatile organic compounds (VOCs) in order to prevent off-gassing.

4. Combustion ratings for the silencer acoustic fill shall be not greater than the following when tested to ASTM E 84, NFPA Standard 255, or UL No. 723:

a. Flamespread Classification 25

b. Smoke Development Rating 50

C. Construction

1. Units shall be constructed in accordance with the ASHRAE Guide recommendations for high pressure duct work. Seams shall be lock formed and mastic filled. Rectangular casing seams shall be in the corners of the silencer shell to provide maximum unit strength and rigidity. Interior partitions shall be fabricated from single-piece, margin-perforated sheets and shall have die-formed entrance and exit shapes so as to provide the maximum aerodynamic efficiency and minimum self-noise characteristics in the sound attenuator. Blunt noses or squared off partitions will not be accepted.

2. Attachment of the interior partitions to the casing shall be by means of an interlocking track assembly. Tracks shall be solid galvanized steel and shall be welded to the outer casing. Attachment of the interior partitions to the tracks shall be such that a minimum of 4 thicknesses of metal exist at this location. The track assembly shall stiffen the exterior casing, provide a reinforced attachment detail for the interior partitions, and shall maintain a uniform airspace width along the length of the silencer for consistent aerodynamic and acoustic performance. Interior partitions shall be additionally secured to the outer casing with welded nose clips at both ends of the sound attenuator.

3. Sound attenuating units shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge from inside to outside the casing. Airtight construction shall be provided by use of a duct sealing compound on the jobsite material and labor furnished by the contractor.

D. Acoustic Performance

1. All silencer ratings shall be determined in a duct-to-reverberant room test facility which provides for airflow in both directions through the test silencer in accordance with ASTM

Specification E477-99. The test facility shall be NVLAP accredited for the ASTM E477-99 test standard. Data from a non-accredited laboratory will not be acceptable. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves, and test chamber sound absorption are eliminated. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self-Noise (SN) Power Levels both for FORWARD FLOW (air and noise in same direction) and REVERSE FLOW (air and noise in opposite directions) with airflow of at least 2000 fpm entering face velocity. Data for rectangular and tubular type silencers shall be presented for tests conducted using silencers no smaller than the following cross-sections:

a. Rectangular, inch: 24x24, 24x30, or 24x36, and

b. Tubular, inch: 12, 24, 36, and 48

E. Aerodynamic Performance

1. Static pressure loss of silencers shall not exceed those listed in the silencer schedule as the airflow indicates. Airflow measurements shall be made in accordance with ASTM specification E477-99 and applicable portions of ASME, AMCA, and ADC airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented.

2.20 VARIABLE AIR VOLUME TERMINAL UNITS

A. Furnish and install variable volume zone boxes of the sizes and capacities shown on the Drawings.

B. The control assemblies shall be pressure independent and shall be able to be reset to any airflow between zero and maximum scheduled CFM. The valves shall be normally open. The differential static pressure of the basic assembly shall not exceed 0.25" W.G. for all sizes with inlet velocities of 2,000 FPM or less.

C. The air valve shall be galvanized steel or die cast aluminum; damper shafts shall operate in rustproof Delrin or equal, self-lubricating bearings. The air valve shall seat against durable gaskets and not exceed a 2% leakage rate per ARI standards.

D. The control device shall be designed to maintain constant flow regardless of inlet flow deflection. Duct inlets at 90° or less to the control device shall not alter the maximum or minimum factory setting by more than 10%. The assembly shall incorporate a multi-point averaging differential pressure sensor mounted on the inlet.

E. The assemblies shall be contained in a welded 26 gauge galvanized steel box internally lined with ½ inch, 1½ lb. insulation complying with NFPA 90A and UL 181 standards.

F. Acoustical lining is to be a scrim reinforced foil laminate using flexible 1½ lb. density insulation meeting the requirements of UL 181 and NFPA 90A. All edges are to be sealed from the airstream, and metal brackets used to secure discharge edges on single duct terminals.

G. Fabricate and install 5 foot (minimum) acoustically lined sheet metal discharge plenum on all air terminal units. Discharge plenum shall be mounted downstream of reheat coils where applicable. Inside dimension of plenum shall be 2" larger in height and 4" larger in width than the outlet of the air terminal unit or reheat coil, whichever is greater. Refer to detail on plans for additional information. This is required for acoustic noise dissipation.

H. Electric Coil: (Note to Editor: electric reheat applications are very limited in most states and are discouraged if hot water can be provided as heat source.) Terminal manufacturer to factory install coil. Coil to be UL listed. They shall be housed in an attenuator section integral with the terminal with element grid recessed from unit discharge a minimum of 5" to prevent damage to elements during shipping. Elements shall be derated nickel chrome, supported by ceramic isolators a maximum of 3.5" apart, staggered for maximum thermal transfer and element life and balanced to ensure equal output per step. The integral SCR control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety device. Provide a primary automatic reset thermal cutout, a manual reset secondary thermal cutout, line fusing, mercury contactors per element, differential pressure airflow switch for proof of flow, and line terminal block. Coil shall be capable of operating under continuous duty at 120°F discharge temperature. Unit shall include an integral door interlock type disconnect switch which will not allow the access door to be opened while power is on. All coils shall come with SCR control. Coordinate final voltages with Div. 26.

I. Controls to be direct digital. Provide boxes without operator. Provide factory mounted low voltage transformer of sufficient capacity to power the DDC controls. Coordinate control with temperature Control Contractor. Provide factory mounted operator and thermostat control if not provided by Control Contractor.

J. Manufacturer: Titus ESV-3000, Price SDV, Trane VC, Enviro-Tec SSD, Carnes AV, Tuttle & Bailey SDV, Nailor 3000, or approved equal by Krueger or Anemostat.

PART 3 - EXECUTION

3.1 DUCTWORK MATERIAL APPLICATION SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Magnetically or Electrically sensitive rooms including MRIs: All ductwork, fittings, grilles/diffuser, etc, shall be constructed of aluminum in and around magnetically/electrically sensitive rooms. Refer to all construction documents for location of these critical rooms.

B. Ductwork is generally diagrammatically indicated and shall be generally installed as indicated. Do not scale Drawings for exact location of ducts. Install ducts to best suit field conditions and cooperate with other trades. Do not penetrate Structural members without consent of Architect or Structural Engineer. Check with Structural drawings prior to locating any penetrations. Duct sizes are indicated as net inside dimensions on the Drawings. The indicated dimensions shall be altered at the job site for the purpose of avoiding interferences and clearance difficulties to other dimensions producing the same air handling characteristics, provided such altered dimensions are

approved by the Architect. Ducts shall be constructed in accordance with the latest edition of codes and standards identified in Part 1 and as shown on the Drawings.

1. Clean and pretreat surfaces before application of sealant. Conform to the manufacturer's cleaning procedures. Install sealants in conformance with manufacturer's instructions.

2. Except where noted, vertical ducts or horizontal ductwork penetrating fire rated ceilings, roofs, walls and floors shall be fire separated with UL listed and labeled fire dampers installed per UL tested assembly including sleeves and retaining angles. Provide additional fire dampers indicated on the Drawings and as otherwise required by the IBC and building inspector. Provide approved firestopping between damper frames and firewalls. Install fire dampers in accordance with NFPA Standards, requirements of the State Fire Marshal, and applicable codes. Ensure that fire dampers are installed in the open position.

3. For penetration of fire rated partitions which meet the IBC Chapter Seven requirements of non-Group H occupancy penetration of tenant separation and corridor walls in buildings with fire sprinklers provide metal sleeves as follows: A minimum 12 inch-long (0.30 m) by 0.060 inch thick (1.52 mm) steel sleeve shall be centered in each duct opening. The sleeve shall be secured to both sides of the wall and all four sides of the sleeve with minimum 1 1/2" inch by 1 ½ inch by 0.060 inch steel retaining angles. The retaining angles shall be secured to the sleeve and the wall with No. 10 screws. The annular space between the steel sleeve and wall opening shall be filled with rock wool batting on all sides

4. Grilles, Registers and Diffusers: Install flush, squared, tightly sealed, and entirely covering sheet metal ductwork and gaskets. Thread sheet metal mounting screws tightly into sheet metal. All frames shall be selected to fit the ceiling type. Verify with Architectural Drawing. Each diffuser, grille and register shall be individually capable of balancing via duct mounted balancing dampers or attached opposed blade dampers. Provide unit opposed blade damper only where individual duct mounted balancing dampers are specifically noted as not provided. Duct connections shall fit securely to necks or collars behind face area. Provide all necessary transition pieces and duct collars to make connections from ductwork to neck sizes. Where ducts connect directly to necks or collars provide a minimum straight duct section of two times the duct diameter to the last elbow. Where minimum straight duct sections are not physically possible provide sheet metal plenum sized for approximately 500 fpm air velocity with duct tapped directly to side of plenum. Where building walls, floors and ceilings form portions of duct or plenum, provide gasketed angles or channels at junction points, securely bolted and sealed to building structure.

5. Install turning vanes in all mitered elbows in all ducts, so that tips are parallel with the sides of the ducts. Vanes shall be single thickness type. Tips of acoustical turning vanes on outside radius shall be flush with acoustical lining.

6. Provide flexible connections to completely isolate fans from direct contact with all sheet metal work.

7. Provide access panels or doors, as required, for access to valves, controllers, fire dampers and humidifier dispersion tubes. Volume Dampers: Provide manual volume dampers in all low pressure supply, return and exhaust branch ductwork to grilles, diffusers, inlet and outlet openings to facilitate balancing of systems. These are to be provided as part of contract whether shown on plans or not. Where ceilings are not accessible, provide access door or remote damper operator.

8. Splitters and splitter dampers shall not be installed.

C. Hangers and Supports: Securely fasten all ductwork to the building construction by means of hangers, supports, guides, anchors, and sway braces to maintain duct alignment, to prevent sagging, and to prevent noise and excessive strain on ductwork due to movement under operating conditions.

1. Maximum spacing between hangers shall not exceed eight (8) feet.

2. Adequately mount and anchor all material and equipment as required. Include lateral bracing as required to prevent horizontal, seismic movement. Refer to IBC and architectural Drawings for seismic requirements.

3. Do not support ductwork from fans or any other pieces of equipment.

4. Powder driver fasteners shall not be used to support rectangular ducts of 40" maximum dimension. Powder driven fasteners shall not be allowed in existing facilities where electronic equipment is located.

5. Support round duct, 30" and larger, with two hangers at each support point.

6. Hangers and supports shall conform to SMACNA section "Hangers and Supports". Nail inserts, hangers and supports to formwork before slabs are poured. Cut off or remove nails, strap-ends and other projections, flush with concrete after forms are removed.

7. Support vertical ducts, passing through floors with two continuous angles screwed to the duct and bearing to the floor and conforming to SMACNA section "Riser Support-From Floor". Blocking or shimming ducts will not be permitted.

D. Other:

1. Fans: Align fans, motors, and drives. Install fans to render bearings accessible for lubrication without dismantling fans or ducts. Provide extended bearing oilers as required. Mount all fans on vibration isolators as specified.

2. Insulation: Properly and neatly apply insulation on all material and equipment and apparatus, as specified, including all fittings. Apply insulation over clean, dry surfaces, with adjoining sections firmly butted together and canvas smoothly pasted over. When vapor barriers are specified, install continuous overall external surfaces of the entire system.

3. Duct Sizing: Where duct sizes are not specifically shown on the plans or must be modified due to physical limitations, supply ducts may be sized at a maximum velocity of 1,500 fpm or 0.08" sp friction per 100 feet, whichever provides the larger duct, and return/exhaust/intake ducts may be sized at a maximum velocity of 1,000 fpm or 0.06" sp friction per 100 feet, whichever provides the larger duct.

3.2 CONSTRUCTION AND SEALING CRITERIA

A. Unless called out otherwise on drawings the pressure classification of ductwork shall be as follows:

Duct system:	**Location**	**Working Pressure**	**Build to SMACNA Pressure Class**	**Build to SMACNA Seal Class:**
Outdoor air intake	From ambient intake to AHU	-1” wc	-2” wc	A
Med press Supply Air	From AHU to active chilled beams	+2” wc	+4” wc	A
Med. Press Return air	From rooms to AHU	-2” wc	-4” wc	B
General exhaust	From grille to exhaust fan	-1” wc	-2” wc	B
General exhaust	From exhaust fan to discharge at ambient	+1” wc	+2” wc	B

B. The default leakage classification of ductwork is as follows:

Duct working press. class:	**+/-3” to +/-10” wc**
SMACNA Seal Class	A
Sealing Applicable	Joints, seams, and all wall penetrations
Rectangular sheet metal SMACNA Leakage Class	6
Round sheet metal SMACNA Leakage Class	3

3.3 COMBINATION FIRE, SMOKE DAMPER INSTALLATION

A. Install per manufacturer’s and UL installation requirements.

B. Interlock operation of all fire smoke dampers to close dampers when the fans associated with the dampers are shut down. This also includes dampers in transfer ducts associated with system fans.

C. For buildings with no fire alarm system all fire smoke dampers shall be interconnected with the HVAC units controls and duct smoke detectors. The detection of smoke at any fire smoke damper shall stop for HVAC unit fans and close all fire smoke dampers. A single test/reset station shall be capable or resetting all devices back to normal operation.

3.4 CONTROL DAMPER INSTALLATION

A. Note that installation of control dampers is a part of the mechanical contractor's work regardless of whether they are specified in this section or as part of products to be selected by the Control Contractor.

B. When electric actuators are provided, dampers shall be installed to allow direct over the shaft mounting of actuators. No connecting rods and stand off brackets shall be necessary.

C. Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking (parallelogramming), bowing, or other installation error.

D. Blades shall close completely. Leakage shall not exceed manufacturer's specifications at rated static.

E. Structural support shall be provided as necessary for all multi-section dampers.

F. Where blankoffs or structural supports obstruct duct or air passages, the decrease in free area shall not exceed 15% of the damper face area unless otherwise specified here or on plans.

G. No individual damper section may exceed 20 sq. ft.

3.5 SEISMIC REQUIREMENTS

A. See Section 230548 for specific requirements.

B. All HVAC equipment and machinery shall be anchored to withstand forces generated by earthquake motions. As a minimum, equipment and equipment frames shall be designed to withstand a force of 100% of the weight of the equipment and frame acting at its center of gravity. Anchorage of the equipment and/or frame to the structure shall be for a force of four times gravity also acting at the center of gravity.

C. The seismic calculations shall be the responsibility of contractor.

3.6 EQUIPMENT

A. Install equipment as shown on plans and in accordance with manufacturer's installation recommendations.

3.7 SUPPLY DIFFUSER AND REGISTER LOCATIONS

A. Coordinate location of supply outlets with ceiling mounted smoke detectors. Locate outlets or outlet distribution so as to prevent airflow from inhibiting the operation of smoke detectors. Locate ceiling outlets a minimum of 3'-0" from smoke detectors.

3.8 PAINTING

A. Where the interior surfaces of ductwork are visible through the blades of supply outlets, return inlets, and exhaust inlets - paint the interior visible surfaces with one coat of flat black paint.

3.9 FIELD QUALITY CONTROL

A. Do not insulate or conceal ductwork before inspection by Owner's Representative, Architect or Engineer. If ductwork is insulated and concealed prior this inspection the Contractor shall remove insulation and ceiling to permit inspection at no additional cost to the Owner. The Contractor shall replace the insulation and ceiling after final inspection at no additional cost to the Owner.

B. Ductwork Deflection Criteria:

1. Maximum inward and/or outward deflection at sheet metal panels shall be 3/4" under maximum static pressure operating conditions. Additional intermediate stiffening angles shall be installed where deflections exceed 3/4".

2. Maximum inward and/or outward deflection at sheet metal elbows and joints shall be 1/4" under maximum static pressure operating conditions. Additional stiffening angles shall be installed where deflections exceed 1/4".

C. Acceptance of duct systems shall be contingent upon conformance with the requirements specified in Section 230593 "Testing, Adjusting and Balancing".

3.10 ADJUSTING AND CLEANING

A. Clean the inside of plenums, casings, enclosures, fans, and accessible ductwork before starting fans. Blowout coils and condensate piping with compressed air. Install a clean set of filters in each system prior to testing and balancing. Proceed with testing and balancing. All dampers shall be locked in place.

END OF SECTION

DUCT SOUND ATTENUATORS

PART 1 GENERAL

1.1 SCOPE

A. Install duct sound attenuators where shown on the Contract Documents, as specified herein, and as needed for a complete and proper installation.

1.2 RELATED WORK

A. Perform work described in other Specification Sections to meet the product and execution requirements of this Specification.

1. Section 01 86 36 – Ambient Noise Performance Requirements.

2. Section 23 31 13 – Air Distribution.

1.3 QUALITY ASSURANCE

A. Use skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Specification.

1.4 SUBMITTALS

A. Submit catalog cut sheets and schedules indicating dynamic insertion loss and regenerated noise by octave band, and pressure drop in the installed configuration, tested in accordance with AMCA 1011-03 and ASTM E 477-99. Submit schedule of attenuators showing module sizes and splitter orientation. Submit full acoustical test reports for representative attenuators if products by manufacturers other than those pre-approved are submitted. Submit manufacturer's recommendations for supporting horizontally oriented splitter baffles for large size attenuators.

1.5 STANDARDS

A. AMCA 1011-03: Certified Ratings Program for Acoustical Duct Silencers.

B. ASTM E477-99; Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

C. SMACNA; HVAC Duct Construction Standards, Metal and Flexible, 3rd ed., 2005.

PART 2 PRODUCTS

2.1 DUCT SOUND ATTENUATORS

A. Attenuators shall be factory fabricated standard or custom products of the following manufacturers or approved equal. Products may be supplied by more than one manufacturer.

1. Innovative Metal Industries, San Bernardino, California

2. Vibro-Acoustics, Toronto, Ontario

3. Dynasonics, Fort Worth, Texas

4. Industrial Acoustics Company, Bronx, New York

5. VAW Systems, Winnipeg, Manitoba

B. Exterior casing shall be 22-gauge minimum with lock-formed seals filled with mastic or continuously welded seams. Interior casing shall be 26-gauge minimum galvanized perforated steel. Attenuators shall be airtight and shall not fail structurally when subjected to a differential pressure of 8” water gauge across the casing.

C. Acoustics ratings of attenuators shall be determined in a duct-to-reverberant room test facility that provides airflow in both directions through the test attenuator. The test procedure shall eliminate all effects caused by end reflection, directivity, flanking, standing waves, and test chamber sound absorption. Acoustics ratings shall include dynamic insertion loss (DIL) and self-noise power levels with airflow up to 2000 feet per minute entering face velocity.

D. Dynamic insertion loss shall be equal or greater than the minimum scheduled. Regenerated noise and static pressure loss shall be no greater than the maximum scheduled.

PART 3 EXECUTION

3.1 DUCT SOUND ATTENUATORS

A. Install in proper direction with respect to airflow, and in accordance with manufacturer's and SMACNA recommendations.

B. Install rectangular attenuators with splitter baffles oriented as scheduled, or in the same plane as the nearest upstream elbow if not scheduled. Center attenuators in duct runs between elbows and transitions to minimize pressure drop unless otherwise noted on the Contract Documents. Provide stiffeners for horizontal splitter baffles in large attenuators as recommended by the manufacturer.

C. Provide flanges and angles for connection to adjacent lined ductwork in such a manner that the internal dimensions of the attenuator and ductwork lining are equal.

D. Make smooth duct size transitions to match attenuators, even when not specifically called out on the Contract Documents.

E. Make all duct connections to attenuators airtight. Blank and seal perimeter and joints in attenuator banks.

F. Support attenuators independently of ductwork.

G. Where attenuators are covered with insulation, lagging or other material, clearly and permanently mark covering material to indicate location, extent, size, manufacturer, model designation, unit tag, and airflow direction of the attenuator.

END OF SECTION

DUCT LINERS

PART 1 GENERAL

1.1 SCOPE

A. Install duct liners where shown on the Contract Documents, as specified herein, and as needed for a complete and proper installation.

1.2 RELATED WORK

A. Perform work described in other Specification Sections to meet the product and execution requirements of this Specification.

1. Section 01 86 36 – Ambient Noise Performance Requirements.

2. Section 23 31 13 – Air Distribution.

1.3 QUALITY ASSURANCE

A. Use skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Specification.

1.4 SUBMITTALS

A. Submit catalog cut sheets indicating octave-band sound absorption coefficients, manufacturer's recommended application procedures, burning characteristics, and compatible fire resistive adhesive.

1.5 STANDARDS

A. ASTM C423-02a; Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method, 2002.

B. SMACNA; HVAC Duct Construction Standards, Metal and Flexible, 3rd ed., 2005.

PART 2 GENERAL

2.1 DUCT LINERS

A. Use duct liner in supply and return exhaust ductwork where indicated on the Drawings.

B. Lining shall be fiber free foam. Lining and adhesive shall be odor free.

C. Surface burning characteristics, in accordance with Underwriters Laboratories Inc. (UL) standard number 723 shall be:

1. Flame spread not more than 25.

2. Smoke development not more than 50.

D. Lining shall meet the Life Safety Standards as established by NFPA 90A.

E. Minimum sound absorption coefficients tested in accordance with ASTM C423-02a and Type A mounting in accordance with ASTM E795-00 shall be:

	Octave Band Center Frequency (Hertz)					
Liner Thickness	**125**	**250**	**500**	**1000**	**2000**	**4000**
	Sound Absorption Coefficient					
1"	0.05	0.18	0.53	.85	0.73	0.66

F. Lining shall be the following or approved equal:

1. Pinta Acoustic Natural Willduct.

2. Evonik Solcoustic.

3. Johns Manville Polycoustic.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install to achieve 100% coverage, with coated side facing air stream. Adhere liner to all interior sides of duct with a minimum of 50% coverage of fire retardant adhesive. When duct width exceeds 12", or height 24", further secure liner with mechanical fasteners on 12" maximum centers. All joints shall butt closely, and all corners shall fit snug. Protect leading edges against erosion with 24 gauge minimum galvanized metal. Heavily coat exposed edges, joints, fasteners and damaged sections of coating with fire resistive adhesive. Install in accordance with applicable SMACNA standards.

3.2 DUCT DIMENSIONS

A. Duct dimensions shown on the Contract Documents are clear inside airway sizes. Increase sheet metal size in both directions by liner thickness.

3.3 PROTECTION

A. Protect duct liner from dirt, debris, moisture, and the elements of weather before and during shipment and installation.

END OF SECTION

FANS AND VENTS

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 1, and shall include, but not necessarily be limited to, the following:

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic Materials and Methods

B. Section 230593: Testing, Adjusting and Balancing

C. Section 230700: Mechanical Insulation

D. Section 230900: Controls and Instrumentation

E. Section 233113: Air Distribution

F. Division 26: Electrical

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide air handling units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Certifications: Provide certified ratings of units based on tests performed in accordance with ARI 430, "Central-Station Air Handling Units."

C. Codes and Standards: Provide air handling units conforming to the requirements of the latest addition of the following:

1. Air Movement and Control Association (AMCA):

a. 99 standards Handbook

b. 210 Laboratory Methods of Testing Fans for Rating [Unit shall bear AMCA Certified Rating Seal]

c. 300 Reverberant Room Method for Sound Testing of Fans [Unit shall bear AMCA Certified Rating Seal]

d. 301 Methods for Calculating Fan Sound Ratings from Laboratory Test Data

e. 500 Test Method for Louvers, Dampers, and Shutters

2. American National Standards Institute (ANSI):

a. 9 Load Ratings and Fatigue Life for Ball Bearings

b. 11 Load Ratings and Fatigue Life for Roller Bearings

c. 900 Test Performance of Air Filter Units

3. Air-Conditioning and Refrigeration Institute (ARI):

a. 350 Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment

b. 410 Forced-Circulation Air-Cooling and Air-Heating Coils

c. 430 Central-Station Air-Handling Units

d. 440 Room Fan-Coil Air-Conditioners

4. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

a. 15 Safety Code for Mechanical Refrigeration

5. National Electrical Manufacturers Association (NEMA): Except for motors, provide electrical components required as part of air handling units, which comply with NEMA Standards.

6. National Fire Protection Association (NFPA): Provide air handling unit internal insulation having flame spread rating not higher than 25 and smoke developed rating not higher than 50:

a. 70 National electrical Code

b. 90A Standard for the Installation of Air Conditioning and Ventilating Systems

c. 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems

7. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Comply with applicable SMACNA standards including "HVAC Duct Construction Standards - Metal and Flexible."

8. Underwriters Laboratories, Inc. (UL): Except for motors, provide electrical components required as part of air handling units, which have been listed and labeled by UL.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, and finishes of materials, installation instructions, sound and vibration test report, and bearing life calculations.

B. Shop Drawings: Submit shop drawings showing unit dimensions, weight loadings, required clearances, field connection details and methods of support. Draw to a scale of 1/4" per one foot. Include field fabricated mixing boxes, dampers and duct connections.

C. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver unit to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect equipment and products against dirt, water, chemical, and mechanical damage. Do not install damaged unit - remove from project site.

1.8 WARRANTY

A. Provide one-year (12 months) warranty. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory authorized service.

1.9 SAFETY PROVISIONS

A. Provide all open drives and fan wheels subject to maintenance and potential entanglement with protective guards or screens meeting OSHA requirements.

PART 2 - PRODUCTS

2.1 GENERAL FAN REQUIREMENTS

A. Construction, Rating and Testing: Provide fans constructed and factory tested in accordance with the Air Moving and Conditioning Association (AMCA). All fan wheels shall be statically and dynamically balanced. Size and capacity as indicated on the Drawings. Provide extended bearing lubrication fittings where necessary to assure accessibility of all lubrication points.

B. Motors and Drives: Provide premium efficiency drip-proof motors with temperature rise not greater than 40 degrees C above ambient temperature. Provide belt drive assembly capable of 150% of the motor rated horsepower on one less than the total number of belts, for belt drives with

two or more belts. All drives shall have adjustable sheaves to allow adjustment of ±20%. Provide two speed, two winding motors where indicated on schedules.

C. Accessories: Provide, as indicated on the Drawings and specified in other paragraphs of this Section, all related accessories to match the fan section, including access sections, diffusion sections, transition sections, flexible connections, vibration eliminators, and belt guards.

D. Submissions: For shop drawings include complete dimensional and physical data, CFM, SP, HP, discharge arrangement, rotation, class, base details, and fan curves.

2.2 INLINE CENTRIFUGAL FANS

A. SPUN ALUMINUM AND STEEL HOUSED CENTRIFUGAL EXHAUST FANS

B. Manufacturer: Models as scheduled manufactured by Greenheck, Carnes, Penn, Twin City or approved equal.

C. General Duty Spun Aluminum Exhaust Fan

1. Direct Drive: Spun aluminum exhaust fans shall be direct drive type.

a. The fan wheel 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. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure and a birdscreen.

b. Motors shall be mounted out of the airstream on vibration isolators. Fresh air for motor cooling shall be drawn into the motor compartment through a large space between the fan shroud and the motor cover. Motors shall be readily accessible for maintenance. A disconnect switch shall be factory installed and wired from the fan motor to a junction box within the motor compartment.

1) Variable speed capability: For all direct drive fans with motors through 3/4 hp, the fan shall be equipped with a DC electronic commutation type motor (ECM). Motor shall be speed controllable to 20% of full speed (80% turndown). Speed shall be controlled by a potentiometer dial mounted at the motor or by a 0-10 vdc signal. Motor shall be 85% efficient at all speeds.

c. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.

d. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number for future identification.

D. INLINE TUBULAR OR SQUARE CENTRIFUGAL FANS

1. Manufacturer: Greenheck, Carnes, or equal.

2. Drive:

   a. Direct Drive: Duct mounted supply, exhaust or return fans shall be of the centrifugal, direct driven in-line type.

3. Housing: The fan housing shall be of the square or cylindrical design as scheduled, constructed of heavy gauge galvanized steel or aluminum and shall include 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.

4. The fan wheel 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.

5. Motors shall be heavy-duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Fan motor shall be premium efficiency, open drip-proof foot mounted, continuous duty and suitable for operation in either vertical or horizontal or angular position.

6. Motors and Drive Access:

   a. Direct Drive: Motors shall be readily accessible for maintenance.

      1) Variable speed capability: For all direct drive fans with motors through ¾" hp, the fan shall be equipped with a DC electronic commutation type motor (ECM). Motor shall be speed controllable to 20% of full speed (80% turndown). Speed shall be controlled by a potentiometer dial mounted at the motor or by a 0-10 vdc signal. Motor shall be 85% efficient at all speeds.

7. A NEMA 1 disconnect switch shall be provided as standard, except with explosion resistant motors, where disconnects are optional. Factory wiring shall be provided from motor to the handy box.

8. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance. The fan manufacturer must furnish published sound power level data based on actual tests on the fan sizes being furnished, and conducted in accordance with current AMCA standards. Such data is to define Sound Power Levels (PWL), re: 10-12 watts for each of the eight (8) frequency bands. Manufacturers furnishing estimate data will not be approved.

9. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate motor starters with Div. 26 and control contractor.

B. Install in accordance with manufacturer's instructions.

C. Examine site to verify if site is ready to receive work. Provide layout drawings of air handlers and fan locations to electrical installer.

D. Install unit on vibration isolators.

E. Install 3" flexible duct connection at inlets and outlets of units.

F. Control installers shall install all wiring associated with control signals into the fan starters.

G. Electrical installer shall install all line voltage power wiring and conduit. Coordinate with Division 26 work.

3.2 MANUFACTURER'S START-UP SERVICES

A. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify unit mounting, verify fan rotation, verify spring isolator adjustments, verify control wiring, verify power wiring, start-up the fans, and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours travel from the job site.

END OF SECTION

AIR FILTRATION

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Air filters and Associated Hardware

2. Air Filter Gauges

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic Materials and Methods

B. Section 233113: Air Distribution

1.4 QUALITY ASSURANCE

A. Codes and Standards: Provide products conforming to the requirements of the following:

1. ASHRAE Standard 52.1

2. Underwriters Laboratory: U.L. 900, U.L. 586

3. NFPA Standard 90A

B. Design Criteria

1. Air flow not to exceed rated capacity

2. Initial and final resistance not to exceed scheduled values.

C. Filters for Schools and State Funded Buildings

1. Air filters shall be of an approved type tested in accordance with State Fire Marshal test method SFM-31.6. Pre-formed filters having combustible framing shall be tested as a complete assembly.

2. Air filters in all occupancies shall be U.L. Class 2 or better, as defined in the test method above.

3. Air filters shall be accessible for cleaning or replacement.

1.5 SUBMITTALS

A. Prior to construction, submit for approval on all materials and equipment.

1. Manufacturer's name and catalog data

2. Installation Data

3. Capacities and Resistances

4. Materials of Construction

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site in containers with manufacturer's stamp or label affixed.

B. Store and protect all products against dirt, water, chemical, and mechanical damage. Do not install damaged products. Remove damaged materials from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Filters: Model numbers given throughout are listed for Eco-Air products.

1. Eco-Air Products, Inc.

2. American Air Filter

3. Westates Carbon

4. Farr

5. Flanders

6. Camfil-Farr

B. Accessories

1. Framing Modules - Eco-Air K-Trac

2. Air Filter Gages - Dwyer

3. Metal Filters - Eco-Air Metal Masters

2.2 FILTER CARTRIDGES

A. Pleated Media Filters (ASHRAE Dust-spot Efficiency 25-30%)

1. Filter media of a high-loft, reinforced, non-woven cotton/synthetic blend.

2. Media support is continuously laminated to an expanded metal grid on the air leaving side.

3. Radial wedge pleat design.

4. Media frame is constructed from two pieces of die-cut high wet-strength carrier board. The frame is designed with diagonal and horizontal support members bonded to the media on the air entering and leaving sides.

5. U.L. Class 2 listed.

6. Basis of design: Eco-Air C35 Series, SFM #3175-394:104, U.L. #R6908 (N)

B. Pleated Media Filters (ASHRAE Dust-Spot Efficiency 50%)

1. Filter media of high efficiency micro-fine glass fiber reinforced with a synthetic backing.

2. Media support is continuously laminated to an expanded metal grid on the air leaving side.

3. Pleat design shall be a radial wedge pleat.

4. The enclosing frame is constructed from moisture-resistant chipboard. Perforated steel support grilles are placed on the upstream and downstream sides. The entire unit is then sealed to insure a positive media-to-frame bond.

5. U.L. Class 2 listed.

6. Basis of design: Eco-Air E55 Series, SFM #3175-394:107, U.L. #R6908 (N)

2.3 MODULAR FRAMING SYSTEM (UPSTREAM OR DOWNSTREAM ACCESS)

A. Medium and high efficient extended surface ASHRAE-rated filters shall be installed in extruded (mill finish) (anodized) aluminum framing modules factory-cut, pre-punched and packaged with all necessary stiffening members and thread cutting screws for field assembly into modules up to 12' high and 14' wide using only a screwdriver or socket wrench.

B. The framing members shall be permanently gasketed with a reinforced nylon pile seal to prevent the bypass of unfiltered air. Each horizontal row of filters shall have a positive spring-loaded sealing device which will allow easy installation and removal of cartridges from either upstream or downstream access as specified and shall secure the seal between cartridges while the bank is in operation.

C. A separate track shall be incorporated for 2" panel pre-filters (if desired or specified) which can be serviced from upstream without disturbing the final filters.

D. Basis of design: Eco-Air K-Trac

2.4 AIR FILTER GAGES

A. Dial type, diaphragm-actuated with external zero adjustment and 3-7/8 inch diameter dial.

B. With two (2) static pressure tips, 2-way valves, tubing and mounting plate (and adjustable signal flag).

C. Range as recommended by filter manufacturer.

D. Basis of design: Dwyer 2000 Series Magnehelic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Filter Bank Construction

1. Filter banks of individual holding frames: install leak tight and structurally sound to eliminate air bypass.

2. Filter banks three filters high or higher: provide 3" wide 16 gauge galvanized steel stiffeners between each vertical row of filters. Caulk frames before installing. After installation caulk any gaps appearing at the leading edge of the holding frames. Use DAP "Butyl Gutter and Lap Sealer." After erection of the filter bank and careful caulking, tape the joints between filter frames on the downstream side with 1" duct tape.

3. Framing modules require sealant and stiffening only between modules and around the periphery.

B. Filter gages are to be installed across each filter bank, mounted where directed. One gage may serve immediately adjacent pre-filter/final filter banks.

C. Temporary Pre-filters for Construction

1. Protect all 40% or higher efficient filters upstream of air handling units during construction with temporary blankets of 2" polyester or fiberglass filter media or 2" disposable panel filters, U.L. Class 2 listed.

2. Remove after air balancing and prior to acceptance.

3. Provide a spare set of these temporary pre-filters or media and install them during construction if required per 3.04B.

3.2 SPARE FILTERS

A. Furnish one new complete spare set of cartridges for each filter bank on completion and acceptance of the work:

B. Install spare set in A. above only if and when directed. If not installed, deliver to owner in sealed carton.

C. Replace all panel filters which are not temporary pre-filters with a new set at job completion and furnish owner with an additional set in sealed cartons.

3.3 FIELD QUALITY CONTROL

A. Filter cartridges shall be capable of easily being loaded and unloaded through access doors in the housings or access sections.

3.4 START-UP PROCEDURE

A. No fan shall be operated unless all particulate filters as specified are installed, along with temporary pre-filter media as outlined in 3.01.C.

B. When the pressure drop of the temporary media reaches 0.5" W.G. during construction, replace it with the spare set. If not used, deliver the spare set to the owner at job completion.

3.5 SCHEDULE

A. See air filter schedule on Drawings for filter model numbers, CFM and sizing data.

END OF SECTION

PACKAGED HVAC UNITS (1-1/2 TO 25 TON)

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Packaged unit
2. Controls and control connections
3. Electrical power connections
4. Roof mounting frame and base

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic HVAC Materials and Methods

B. Section 230593: Testing, Adjusting and Balancing

C. Section 230700: Mechanical Insulation

D. Section 233113: Air Distribution

E. Division 26: Electrical

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide packaged units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Codes and Standards: Provide air handling units conforming to the requirements of the latest addition of the following:

1. Air Movement and Control Association (AMCA):
    a. 99 - Standards Handbook
    b. 210 - Laboratory Methods of Testing Fans for Rating [Unit shall bear AMCA Certified Rating Seal]

c. 300 - Reverberant Room Method for Sound Testing of Fans [Unit shall bear AMCA Certified Rating Seal]

d. 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data

e. 500 - Test Method for Louvers, Dampers, and Shutters

2. American National Standards Institute (ANSI):

a. 9 - Load Ratings and Fatigue Life for Ball Bearings

b. 11 - Load Ratings and Fatigue Life for Roller Bearings

c. 900 - Test Performance of Air Filter Units

3. Air-Conditioning, Heating and Refrigeration Institute (AHRI):

a. 210/240 – Performance Rating of Unitary Air Conditioning & Air-Source Heat Pump Equipment

b. 270 - Sound Rating of Outdoor Unitary Equipment

c. 340/360 – Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment

4. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

a. 15 - Safety Code for Mechanical Refrigeration

a. 193 – Method of Test for Determining the Air Leakage of HVAC Equipment. All systems that move less than 3,000 cfm shall comply with less than 1.4% cabinet leakage rate.

5. National Electrical Manufacturers Association (NEMA): Except for motors, provide electrical components required as part of air handling units, which comply with NEMA Standards.

6. National Fire Protection Association (NFPA): Provide unit internal insulation having flame spread rating not higher than 25 and smoke developed rating not higher than 50:

a. 70 - National electrical Code

b. 90A - Standard for the Installation of Air Conditioning and Ventilating Systems

c. 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems

7. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Comply with applicable SMACNA standards including "HVAC Duct Construction Standards - Metal and Flexible."

8. Underwriters Laboratories, Inc. (UL): Except for motors, provide electrical components required as part of units, which have been listed and labeled by UL.

9. Minimum Efficiency: Minimum efficiencies shall meet or exceed the values listed in this specification.

1.5 PRODUCT SUBSTITUTIONS

A. **The Contractor shall certify the following items are correct when using substituted products other than those scheduled or shown on the drawings as a basis of design:**

1. The proposed substitution does not affect dimensions shown on drawings.

2. The Contractor shall pay for changes to building design, including engineering design, detailing, structural supports, and construction costs caused by proposed substitution.

3. The proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.

4. Maintenance and service parts available locally are readily obtainable for the proposed substitute.

B. The Contractor further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item.

C. The Contractor agrees that the terms and conditions for the substituted product that are found in the contract documents apply to this proposed substitution.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for packaged units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, installation instructions, sound and vibration test report, and bearing life calculations.

B. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals; in accordance with requirements of Division 1.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Protect units against dirt, water, chemical, and mechanical damage. Do not install damaged units - remove from project site.

1.9 WARRANTY

A. Provide general one year (12 months) warranty with five (5) year warranty on compressors. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory authorized service.

PART 2 - PRODUCTS

2.1 PACKAGED ROOFTOP HEATING/COOLING UNIT (3 TO 25 TONS)

A. General:

1. Outdoor rooftop mounted, electrically controlled heating and cooling unit. Unit shall discharge supply air downward or horizontally as shown on contract drawings.

2. Unit shall be rated in accordance with ARI Standards 210240 and 270. Designed in accordance with UL Standard 465.

3. Unit shall be designed to conform to ANSI/ASHRAE 15.

4. Unit shall be UL tested and certified in accordance with ANSI Z21.47 Standards and CSA or CGA certified as a total package.

5. Roof curb shall be designed to conform to NRCA Standards.

6. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

B. Manufacturers: Carrier, Trane, Daikin, York, Lennox, Aaon, Engineered-Air.

C. Equipment:

1. General:

a. Factory assembled, single piece heating and cooling unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, refrigerant charge (R-410A) and special features required prior to field start-up.

2. Unit Cabinet:

a. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a prepainted baked enamel finish on all externally exposed surfaces.

b. Insulation: See Table below

c. Cabinet panels shall be easily removable for servicing. See Table below.

d. Filters will be accessible through a hinged access door, and will require no panel or screw removal.

e. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.

f. Unit shall have a factory installed internal condensate drain trap made of a non-corrosive material, providing a minimum 3/4" connection.

3. Fans:

a. Indoor blower (evaporator fan):

1) Fan shall be direct drive.

2) Bearings shall be sealed, permanently lubricated ball bearing type for longer life and lower maintenance.

b. Indoor blower shall be made from steel with a corrosion resistant finish and shall be dynamically balanced.

c. Outdoor (condenser) fan shall be of the direct driven propeller type and shall discharge air vertically upward.

4. Compressor:

a. Variable capacity scroll

b. Fully hermetic type, internally protected.

c. Factory rubber shock mounted and internally spring mounted for vibration isolation.

d. Equipped with a factory installed crankcase heater to minimize liquid refrigerant accumulation in compressor during shutdown and prevent refrigerant dilution of oil.

e. See matrix below for specific compressor requirements.

5. Coils:

a. Evaporator and condenser coils shall have fins mechanically bonded to seamless tubes with all joints brazed.

b. Tube sheet openings shall be belled to prevent tube wear.

c. Evaporator coil shall be of the full-face active design, degreased at the factory.

6. Heating Section:

a. Gas Heating Section:

1) Induced draft combustion type with intermittent direct spark ignition system and redundant main gas valve.

2) Heat exchanger: See matrix below.

3) All gas piping shall enter the unit cabinet at a single location.

b. Electric Heating Section:

1) The rooftop unit shall include an electrical resistance heating coil section. The electric heating coil module shall be factory installed downstream of the supply air fan in the heating section of the rooftop unit.

2) Heating elements shall be constructed of a low watt density, nickel - chromium alloy resistance wire with intermediate supports that include ceramic bushings. The electrical relay contactors shall be of the full line-breaking type with all the electrical power legs being disconnected when the contactors are not energized. All electrical circuit wiring shall be designed with copper conductors, aluminum wires are not acceptable. Heating element branch circuits shall be individually fused to a maximum of 48 Amps per NEC requirements. The rooftop unit shall have a single point power connection. The power supply for the electric heater shall be factory wired into the units main power block or disconnect switch.

3) The heating modules shall have an automatic reset, high temperature limit safety protection. A secondary high limit protection shall also be provided that requires a manual reset. An airflow switch shall be provided with the heating module to prevent the electric heater from operating in the event of no airflow.

4) The electric heater elements shall be controlled by the factory installed DDC unit control system. Control shall be per the matrix below.

5) Field installed heating modules shall require a field ETL certification. Duct heaters mounted within the rooftop unit in the field shall not be acceptable. The manufacturer’s rooftop unit ETL certification shall cover the complete unit including the electric heating modules.

c. Heat Pump Heating Section:

1) The evaporator coil, condenser coil, compressors and refrigerant circuit shall be designed for heat pump operation. The refrigerant circuit shall contain a 4 way reversing valve for the heat pump operation. The outdoor coil shall have an electronic expansion valve to control the refrigerant

flow. The unit controller shall modulate the expansion valve to maintain compressor operation within the compressor operational envelope.

2) The refrigerant system shall have a pump-down cycle.

3) The unit shall have an electric resistance heating coil for auxiliary heating. When the heat pump operation cannot maintain the discharge air temperature setpoint the electric heating coil shall temper the airstream to the discharge air temperature setpoint.

7. Refrigerant Components: Refrigerant circuit components shall include:

a. Refrigerant feed system.

b. Filter drier.

c. Service gauge connections on suction, discharge and liquid lines.

8. Filter Section:

a. Standard filter section shall consist of factory installed low velocity, disposable filters of commercially available sizes.

b. Filter face velocity shall not exceed 500 fpm at nominal airflows.

9. Controls and Safeties:

a. Unit Controls: Unit shall be complete with self-contained low voltage control circuit protected by a manually resettable circuit breaker.

b. Fault Detection and Diagnostics: Provide an on-board fault detection and diagnostics system capable of identifying specific faults including alarm for low refrigerant charge, failed economizer function.

c. Safeties:

1) Unit shall incorporate a solid state compressor protector which provides reset capability at the space thermostat, should any of the following standard safety devices trip and shut off compressor:

a) Compressor over temperature, overcurrent.

b) Loss of charge/low pressure switch.

c) Freezestat, evaporator coil.

d) High-pressure switch.

10. Operating Characteristics:

    a. Unit shall be capable of starting and running at 115° F ambient outdoor temperature per maximum load criteria of ARI Standard 210/240.

    b. Compressor with standard controls shall be capable of operation down to 25° F ambient outdoor temperature.

    c. Unit provided with fan time delay of 55 seconds to prevent cold air delivery before heat exchanger warms up.

11. Electrical Requirements: All unit power wiring shall enter unit cabinet at a single factory predrilled location.

12. Motors:

    a. Compressor motors shall be cooled by suction gas passing through motor windings and shall have line break thermal and current overload protection.

    b. Indoor blower motor shall have permanently lubricated bearings and inherent automatic reset thermal overload protection.

    c. Outdoor totally enclosed motor shall have permanently lubricated bearings, and inherent automatic reset thermal overload protection.

    d. Induced draft motor shall have permanently lubricated sealed bearings and inherent automatic reset thermal overload protection.

13. Medium Size Package Rooftop Unit (7-1/2 -25 ton) Equipment Conformance List: The scheduled units within this size category shall be configured with the following selected feature options.

Medium Size Package Rooftop Unit (7-1/2 -25 ton) Equipment Requirements			
	Feature	**Specification Options**	**Specified Alternative**
Unit Case			
	Wall Construction	Single wall	X
		Double wall	
	Liner options	Foil faced insulation	X
	Insulation	1/2” Insulation	
		1” insulation	X
	Maintenance Access	Tool required	
		Tool free	X
		Hinged panels	X
		Non-hinged panels	

Medium Size Package Rooftop Unit (7-1/2 -25 ton) Equipment Requirements			
	Feature	**Specification Options**	**Specified Alternative**
	Condensate pan	Plastic	
		Galvanized	
		Stainless	X
Supply Fan			
	Fan Access	Slide out cassette	X
		Non-slide out	
	Fan Wheel Construction	Fully welded fan wheels	X
	Motor type	ECM motor	
		Conventional	X
	Drive	Belt and sheaves	
		Direct	X
Relief Air			
	Relief provisions	Barometric damper only	
		Prop relief fan with damper	X
		Return fan	
Compressor			
	Type compressor	Scroll	
		Digital Scroll	X
		Variable speed	
Cooling Efficiency			
		EER	See unit schedule
		IEER or SEER	See unit schedule
Evaporator	Coil Construction	Cu tube/Al fin	X
		Epoxy coated Cu/Al coil	
Condenser			
	Coil Construction	Cu tube/Al fin	X
		All aluminum coil	
		CU tube/CU fin	
		Coated Condenser coil	
	Condenser fan	ECM type motor	X
		Constant speed motor	
Reheat	Reheat Coil	Modulating hot gas reheat coil	X
		Not required	
Filters			
	Filter type	2" MERV 8 pleated filter	X
		4" MERV 13 pleated filter	X
Electric Heat			
	Control	Step controller	

Medium Size Package Rooftop Unit (7-1/2 -25 ton) Equipment Requirements			
	Feature	**Specification Options**	**Specified Alternative**
		SCR controller option	X
Heat Pump			
Controls			
	Economizer	Fully integrated economizer controls	X
	Single Zone VAV		X
	Full VAV Control		X
	CO2 Sensor		X
	OSA Monitor and controller		X
	Dehumidification Control		X
	Factory digital controls	Zone controls by others	X
		Equip with zone controls and unit programming panel	
	BAS interface options	BACnet interface	X
		LonTalk Interface	
	Smoke Detector	Provided by div 26	X
Electrical			
	Single point connection		X
	Powered convenience outlet		X

14. Other Features and Required Equipment: Provide the following with units.

    a. Roof Curb:

        1) Formed galvanized steel with wood nailer strip and capable of supporting entire unit weight.

        2) Seismically restrained spring isolating curb (See Section 230548 Vibration Seismic)

    b. Head Pressure Control Package:

        1) Consists of solid-state control and condenser coil temperature sensor to maintain condensing temperature between 90° F and 110° F at outdoor ambient temperatures down to -20° F by either condenser fan speed modulation or condenser fan cycling.

c. Remote Control Panel: Panel shall be a decorative, indoor, wall mounted panel consisting of:

1) Two stage heat/two stage cool thermostat.

2) Automatic changeover.

3) System switch with HEAT - COOL - AUTO - OFF settings.

4) Fan switch with ON - AUTO settings.

5) Indicator lights for HEAT - COOL - FAN operation.

6) Three unused indicator lights for field use.

2.2 PROGRAMMABLE THERMOSTAT

A. Thermostat with 365 day programmability that allows the building occupants to program the temperature setpoints for at least four periods within 24 hours. A minimum of 5 holidays shall be programmable for up to 5 years. Daylight savings shall be provided as a standard feature in the programming calendar.

1. Manufacturers: Honeywell VisionPRO 8000 Series, Honeywell Prestige THX 9000 Series, Honeywell TB7600 Series, Venstar ColorTouch T6000 Series, EnTouch Pro/One or equal.

B. Minimum thermostat features shall include, but not limited to, the following:

1. The thermostat shall have a touch screen and shall display both room temperature and cooling and heating setpoints simultaneously, and shall indicate when cooling or heating and what stage is energized on the main screen.

2. Programming may be accomplished at the thermostat, or via free software. The program shall have an override mode to provide comfort on demand while in an unoccupied period. The unoccupied override shall be adjustable by pushing an override button and selecting thirty minute increments, up to four hours.

3. The setback override shall be activated by a single button, and deactivated on demand.

4. Setpoints shall be adjustable from 35^0F to 99^0F, with a minimum 5°F adjustable deadband available.

5. Dual setpoints shall be provided with the ability to individually set heating and cooling temperatures with adjustable heating and cooling setpoint limits. Initial occupied mode cooling setpoint of 75^0F and heating setpoint of 70^0F. Initial unoccupied mode cooling setpoint of 85^0F and heating setpoint of 55^0F

C. The thermostat shall be capable of independently controlling an individual system, with up to three stages of heating and two stages of cooling, fan, and reversing valve.

1. For heat pumps an adjustable auxiliary heat lockout temperature based on outdoor temperatures shall be provided.

2. An Emergency Heat switch will be provided on the touch screen when set in heat pump mode.

D. The fan shall be programmable to operate continuously during occupied periods and in auto mode during unoccupied periods.

E. Controls shall be capable of alternating compressor starting sequence with a built in lead-lag operating logic.

1. Equipment protection options shall be provided to prevent compressor short-cycling, and to limit the number of cycles per hour. These options shall be overridden for use with zoning systems.

F. Pre-Occupancy purge cycle that energizes the fan before the programmed occupancy time, adjustable up to three (3) hours in 15-minute increments.

1. Configurable terminals shall be provided for remote indoor, remote outdoor or remote supply air temperature sensing.

G. Multiple security levels to limit access to programming and configuration and will allow for a custom passcode. The various security levels will allow controlled access to programming, unoccupied override, and thermostat mode.

H. All programming information, except time of day, shall reside in nonvolatile memory. During a power failure, the thermostat shall maintain its program indefinitely without the use of batteries.

I. Wi-Fi capable and controlled through local wireless internet routers. The thermostat shall be capable of receiving an automated demand response signal from the local electrical utility, and automatically reset the cooling and heating setpoints during the demand event. When the demand event is terminated by the local electrical power utility, the thermostat will reset to normal occupied and unoccupied setpoints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that mounting surface, e.g. roof, is ready to receive work.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide layout drawings of units, locations and power requirements to electrical installer.

C. Install minimum 30% efficiency air filters in unit during installation phase. Do not operate the unit without filters in place.

D. Mount rooftop unit on:

1. Factory built roof mounting frame. Install roof mounting frame level. OR

2. Seismically restrained spring isolating curb.

E. Install 3" flexible duct connection at inlets and outlets of units.

F. Install condensate drain piping and traps in accordance with manufacturer's instructions and as shown on the Drawings.

G. Control installers shall install thermostat and all wiring associated with control signals into the units.

H. Electrical installer shall install all line voltage power wiring and conduit. Coordinate with Division 26 work.

I. Install a new set of filters prior to final air balance and substantial completion.

3.3 MANUFACTURER'S START-UP SERVICES

A. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify unit mounting, verify fan rotation, verify spring isolator adjustments, verify control wiring, verify power wiring, start-up the fans, and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours travel from the job site.

END OF SECTION

COMPUTER ROOM AIR CONDITIONERS

PART 1 - GENERAL

1.1 GENERAL SUMMARY

A. These specifications describe requirements for a computer room environmental control system. The system shall be designed to maintain temperature and humidity conditions in the rooms containing electronic equipment.

B. The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements of the room

C. Section Includes:

1. Ceiling-mounted computer-room air conditioners.

1.2 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.3 RELATED WORK SPECIFIED ELSEWHERE

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

B. Section 230500: Basic HVAC Materials and Methods

C. Section 230900: Building Automation System (BAS) Controls

D. Division 26: Electrical

1.4 DEFINITION

A. BAS: Building automation system.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For computer-room air conditioners. Include plans, elevations, sections, details, and attachments to other work.

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.

C. Color Samples: For unit cabinet, discharge grille, and exterior louver and for each color and texture specified.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, using input from Installers of the items involved.

B. Seismic Qualification Certificates: For computer-room air conditioners, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals.

1.8 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. Fan Belts: Two set(s) for each belt-driven fan.

2. Filters: Two set(s) of filters for each unit.

1.9 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide complete computer room air conditioning units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Codes and Standards: Provide air handling units conforming to the requirements of the latest addition of the following:

1. Air Movement and Control Association (AMCA):

a. 99 - Standards Handbook

b. 210 - Laboratory Methods of Testing Fans for Rating [Unit shall bear AMCA Certified Rating Seal]

c. 300 - Reverberant Room Method for Sound Testing of Fans [Unit shall bear AMCA Certified Rating Seal]

d. 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data

e. 500 - Test Method for Louvers, Dampers, and Shutters

2. American National Standards Institute (ANSI):

a. 9 - Load Ratings and Fatigue Life for Ball Bearings

b. 11 - Load Ratings and Fatigue Life for Roller Bearings

c. 900 - Test Performance of Air Filter Units

3. Air-Conditioning, Heating and Refrigeration Institute (AHRI):

a. 240 - Unitary Air-Source Heat Pump Equipment

b. 270 - Sound Rating of Outdoor Unitary Equipment

4. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

a. 15 - Safety Code for Mechanical Refrigeration

5. Electrical Components, Devices, and Accessories:

a. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

b. National Electrical Manufacturers Association (NEMA): Except for motors, provide electrical components required as part of air handling units, which comply with NEMA Standards.

6. National Fire Protection Association (NFPA): Provide unit internal insulation having flame spread rating not higher than 25 and smoke developed rating not higher than 50:

a. 70 - National electrical Code

b. 90A - Standard for the Installation of Air Conditioning and Ventilating Systems

c. 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems

7. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Comply with applicable SMACNA standards including "HVAC Duct Construction Standards - Metal and Flexible."

8. Underwriters Laboratories, Inc. (UL): Except for motors, provide electrical components required as part of units, which have been listed and labeled by UL.

9. Minimum Efficiency: Minimum efficiencies shall meet or exceed the values required by the local energy code.

A. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.10 COORDINATION

A. Coordinate layout and installation of computer-room air conditioners and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate installation of computer-room air conditioners with computer-room access flooring Installer.

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

D. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.

2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CEILING HUNG UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

1. Compu-Aire, Inc.

2. Data Aire Inc.

3. Stulz-ATS.

B. Description: Self-contained, factory assembled, prewired, and pre-piped; consisting of cabinet, fan, filters, and controls.

C. Cabinet: Galvanized steel with baked-enamel finish, insulated with 1/2-inch- (13-mm-) thick duct liner.

1. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Supply-Air Fan: Forward curved, centrifugal, and directly driven by two-speed motor.

E. Refrigeration System:

1. Compressor: Hermetic, with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.

2. Refrigeration Circuit: Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.

3. Refrigerant: R-410A

4. Refrigerant Evaporator Coil: Direct-expansion coil of seamless copper tubes expanded into aluminum fins.

a. Mount coil assembly over stainless-steel drain pan[complying with ASHRAE 62.1] [and] [having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir].

5. Remote Air-Cooled Refrigerant Condenser: Integral, copper-tube aluminum-fin coil with propeller fan, direct driven.

6. Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.

F. Electric-Resistance Heating Coil: Finned-tube electric elements with contactor, dehumidification relay, and high-temperature-limit switches.

G. Filter: 1-inch- (25-mm-) thick, disposable, glass-fiber media.

1. Initial Resistance: <0.25 inches wg >.

2. Recommended Final Resistance: <0.5 inches wg >.

3. Arrestance (ASHRAE 52.1): 90 percent.

4. Merv (ASHRAE 52.2): 8.

H. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

I. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature and humidity-control modules, time-delay relay, heating contactor, and high-temperature thermostat. Provide solid-state, wall-mounted control panel with start-stop switch**,** adjustable humidity set point**,** and adjustable temperature set point.

2.2 FAN MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.3 REQUIRED OPTIONS

A. Firestat

1. The firestat shall immediately shut down the environmental control system when activated. The firestat shall be mounted in the electrical panel with the sensing element in the return air.

B. Automatic Shut-off Valve

1. Provide an automatic two-position valve on the chilled water return line.

C. Leak Detection

1. Local sensing at units: (Max of two per unit)

2. Cable leak detection for underfloor plenum.

a. Provide 45 ft long leak detection cable. Upon detection of a leak, both the chilled water control valve (supply line) and shut-off valve (return line) shall close.

D. Seismic Floor Stand

1. The seismic floor stand shall be constructed of a heliarc welded tubular steel frame. The floor stand shall have adjustable legs with vibration isolation pads. The floor stand shall be ___ inches high.

E. Temperature and humidity Recorder

1. Provide a 7 day/24 hour temperature and humidity recorder of the full scope, two pen, surface mounted type with 100 recording charts, one red and one blue bottle of recording ink. Recorder shall be a 110 volt, single phase, 60 Hz (50 Hz) power supply.

F. Lock-Out Relays

1. Provide lock-out relays for the humidifier and reheat. Relays shall lock-out humidifier and reheat upon loss of the primary power feed to the air conditioning unit.

G. Smoke Detector

1. The smoke detector shall immediately shut down the environmental control system and active the alarm system when activated. The smoke detector shall be mounted in the electrical panel with the sensing element in the return air compartment.

H. Remote Shutdown.

1. Provide contacts for remote shutdown of unit by area smoke detection system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for hydronic piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.

B. Computer-Room Air-Conditioner Mounting: Install restrained spring isolators. Comply with requirements for vibration isolation devices specified in Section 230548

C. Air-Cooled Refrigerant Condenser Mounting: Install restrained spring isolators. Comply with requirements for vibration isolation devices specified in Section 230548.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Drainage Connections: Provide adequate connections for condensate drain

D. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Provide shutoff valves and piping.

3.4 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. Inspect for and remove shipping bolts, blocks, and tie-down straps.

2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.

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.

D. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

F. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION

MINI-SPLIT AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Split air conditioning unit.

2. Controls and control connections.

3. Electrical power connections.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic Materials and Methods

B. Section 230593: Testing, Adjusting and Balancing

C. Section 230700: Mechanical Insulation

D. Section 230900: Controls and Instrumentation

E. Section 232123: Pumps and Hydronic Specialties

F. Section 232300: Refrigerant Piping Systems

G. Section 233113: Air Distribution

H. Division 26: Electrical

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide packaged units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Codes and Standards: Provide air handling units conforming to the requirements of the latest addition of the following:

1. Air Movement and Control Association (AMCA):

a. 99 Standards Handbook

b. 210 Laboratory Methods of Testing Fans for Rating Unit shall bear AMCA Certified Rating Seal

2. Air-Conditioning and Refrigeration Institute (ARI):

a. 210 Unitary Air-Conditioning Equipment

b. 270 Sound Rating of Outdoor Unitary Equipment

3. National Electrical Manufacturers Association (NEMA): Except for motors, provide electrical components required as part of air handling units, which comply with NEMA Standards.

4. National Fire Protection Association (NFPA): Provide unit internal insulation having flame spread rating not higher than 25 and smoke developed rating not higher than 50:

a. 70 National Electrical Code

b. 90A Standard for the Installation of Air Conditioning and Ventilating Systems

c. 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems

5. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Comply with applicable SMACNA standards including "HVAC Duct Construction Standards - Metal and Flexible."

6. Underwriters Laboratories, Inc. (UL): Except for motors, provide electrical components required as part of units, which have been listed and labeled by UL.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for systems with air handler units, evaporator coils, and outdoor condensing units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, installation instructions, sound and vibration test report, and bearing life calculations.

B. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals; in accordance with requirements of Division 01.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store/protect products under provisions of Division 01. Protect units against dirt, water, chemical, and mechanical damage. Do not install damaged units - remove from project site.

1.8 WARRANTY

A. Provide general one year (12 months) warranty from date of installation and five (5) year warranty on compressors under provisions of Division 01. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory authorized service.

PART 2 - PRODUCTS

2.1 SPLIT SYSTEM AIR CONDITIONING UNIT WITH INDOOR FAN COIL

A. Acceptable Manufacturers: Mitsubishi, LG, Daikin or approved equal.

B. Indoor Fan Coil Unit

1. General:

a. Factory fabricated fan coil units of the size, type configuration and capacity as scheduled on the drawings. Units shall be self-contained, factory assembled and pre-wired with condensate pump.

b. All pressure drops, horsepowers and dimensions shown are maximum allowable. All capacities shown are minimum allowable. All units must have AMCA certified performance data for fans tested in the unit casings. Bare fan certification without casing is not acceptable.

c. Manufacturers unable to meet this criteria will only be considered as an alternate to specified and as a deduct to base bid. Manufacturers listed by name do not imply that their standard construction meets the specifications nor that they are approved. All manufacturers are required to meet all details of this specification without exception.

2. Unit cabinet shall be galvanized steel with powder coated baked enamel finish.

3. Fan Assembly

a. Direct-drive, double-inlet fan wheels shall have forward-curved blades, and be statically and dynamically balanced, with scrolls and fans constructed of galvanized steel.

b. Rotating assembly shall provide a rigid support for motor and fan assembly. Assembly shall be accessible and entire assembly shall be removable for maintenance.

c. Motor shall be minimum two speed permanent split capacitor type.

4. Coils shall be ARI certified. All coil shall constructed of non-ferrous seamless copper and pressure tested in the factory.

5. Filter shall be one inch thick pleated.

6. Unit Suspension: Units shall be provided with factory welded mounting clips for mounting of units.

7. Electrical: The unit electrical power shall be 115 volts, 1 phase, 60 hertz.

8. Controls

a. Unit shall have a wired controller to perform input functions necessary to operate the system.

b. The controller shall consist of an On-Off switch, Cool/Dry-Fan selector, Thermostat setting, Timer Mode, High-Low fan speed, Auto Vane selector, Test Run switching and Check Mode switching.

c. Temperature changes shall be by 2°F increments with a range of 65 - 87°F.

d. The control system shall consist of two (2) microprocessors interconnected by a single non-polar two wire cable.

e. Wiring shall run direct from the indoor unit to the controller with no splices.

f. Manufacturer shall provide 2 conductor 18 Ga. stranded wire for connection to remote controller.

g. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit.

h. Normal operation of the remote controller provides individual system control in which one remote controller and one indoor unit are installed in the same room.

i. The control voltage from the controller to the indoor unit shall be 12 volts, DC.

j. The control voltage between the indoor unit and the outdoor unit shall be 12 volts, DC.

k. The system shall be capable of automatic restart when power is restored after power interruption.

l. The system shall include self-diagnostics including total hours of compressor run time.

m. The microprocessor within the wall mounted remote controller shall provide automatic cooling, display set point and room temperature, 24 hour on/off timer so that automatic operation function display, check mode for memory of most recent problem.

C. Outdoor Condensing Unit:

1. General: Provide remote outdoor compressor units consisting of hermetic compressor with overload protection, direct drive condenser fan, aluminum fin/seamless copper tube coil, strainer, high and low pressure switches, accumulator, and thermostatic expansion valve.

2. Low Ambient Control: System shall be capable of operating at 0ºF ambient temperature.

3. Unit Cabinet: Galvanized steel with powder coat enamel finish.

4. Condenser Fans: Direct drive propeller type. Motors to be totally enclosed, single phase, with Class B insulation and permanently lubricated bearings. Fan shall be mounted for low noise. Fan blades to be statically and dynamically balanced.

5. Coil: Aluminum fins mechanically bonded to copper tubes.

6. Refrigerant Components: Liquid tube shutoff valve with sweat connection, suction tube shutoff valves with sweat connection, R-401C refrigerant, and accumulator.

7. Compressor: Hermetically sealed two-speed compressor mounted on rubber mountings. Protection to include internal thermal overloads. An internal pressure relief valve to provide high-pressure protection to the refrigerant system. Provide external service valves for the refrigerant circuit. A crankcase heater shall be factory mounted on the outside of the compressor.

8. Electrical: Unit electrical power shall be 208/230 volts, 1 phase, 60 hertz. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control voltage between the indoor unit and the outdoor unit shall be 12 volts, DC.

PART 3 - PRODUCTS

3.1 EXAMINATION

A. Verify that mounting surfaces are ready to receive work.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide layout drawings of units, locations and power requirements to electrical installer.

C. Install air filters in unit during installation phase. Do not operate the unit without filters in place.

D. In the case of suspended units, mount the fan coil units on springs or from spring hangers as required and as shown on Drawings. Provide Mason #DNHS combination isolator hangers to fully support horizontal units hung from building framing.

E. Provide 4" high concrete pad extending 6" beyond edge of condensing unit on all sides. Attach condensing unit to concrete pad with concrete anchors and angle brackets.

F. Install condensate drain piping and traps in accordance with manufacturer's instructions and as shown on the Drawings.

G. Install copper refrigerant piping and insulate lines.

H. Install controller and all wiring associated with control signals between air handling unit and condensing unit. Conceal low voltage wiring in building structure, or inside the refrigerant pipe insulation, or in conduit.

I. Electrical installer shall install all line voltage power wiring and conduit. Coordinate with Division 26 work.

J. Install a new set of filters prior to final air balance and substantial completion.

3.3 MANUFACTURER'S START-UP SERVICES

A. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify unit mounting, verify fan rotation, verify spring isolator adjustments, verify control wiring, verify power wiring, start-up the fans, and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours travel from the job site.

END OF SECTION

BASIC ELECTRICAL REQUIREMENTS

PART 1 - - GENERAL

1.1 WORK INCLUDED

A. Basic electrical requirements for all Division 26 Sections.

1.2 RELATED WORK

A. General requirements specifically applicable to Division 26 in addition to the provisions of Division 1.

B. Work specified in other Divisions and Divison 26: (See Appendix A - Table of Contents)

1.3 QUALITY ASSURANCE

A. Provide equipment and materials which conform to the standards effective as of the date of the Contract Documents as promulgated by the following bodies:

1. Underwriters' Laboratories (UL).
2. National Electrical Manufacturers' Association (NEMA).
3. Electrical Testing Laboratories (ETL).
4. American National Standards Institute (ANSI).
5. Insulated Cable Engineers Association (ICEA).
6. California State Fire Marshal (CSFM).
7. California Electrical Code (CEC).
8. Titles 8, 19 and 24 of the California Code of Regulations (CCR).

1.4 SUBMITTALS

A. Submit electronic copies of manufacturer's submittal sheets or shop drawings for major items of electrical equipment and for any items specifically requested by the Electrical Engineer. When possible, make all electrical submittals at the same time.

1.5 INSTALLATION DRAWINGS

A. Prepare dimensionally accurate floor plans of each electrical and signal room and/or closet, fire control room and the like, drawn to 1/4" scale minimum. Submit electronic copies for review with two prints for Architect's record. Indicate all equipment within the rooms to scale based on shop drawing data, include structural support for suspended equipment and description of seismic bracing and fastening. Indicate system and equipment grounding details as applicable. Review elevator machine room shop drawings and coordinate location of electrical gear to maintain clearances. Submit with shop drawings.

B. Where conduit runs, 2" trade size and larger, are run in exposed locations, prepare dimensionally accurate floor plans indicating routing, coordinated with work of other trades and the structure. Submit legible reproducible transparencies with two prints for review.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain Record Documents which clearly indicate variances from the specified systems and which accurately locate all underground electrical conduits and structures.

1.7 EXAMINATION OF DOCUMENTS

A. Before submitting a bid, visit the Project Site and become familiar with conditions which may be pertinent to, or affect the cost of, the electrical installation.

B. Become acquainted with the Work of other installers whose activities will adjoin or be affected by the electrical Work. Consult with these other installers and study all pertinent Drawings in order to coordinate the Work and to avoid conflicts, omissions and delays.

1.8 PERMITS AND FEES

A. Obtain and pay for all necessary electrical permits and fees.

1.9 SUBSTITUTIONS

A. Refer to other Sections of these Specifications for substitution requirements.

1.10 DRAWINGS

A. For purposes of clarity and legibility, the electrical Drawings are essentially diagrammatic. although the size and location of electrical equipment is drawn to scale wherever possible, make use of all data in all of the Contract Documents, and verify this at the Project Site. Determine the exact location of conduits, outlets and equipment by the study of details, shop drawings and/or the Architect's directions.

B. The electrical Drawings show the required size and points of termination of the conduits and the quantity and size of the conductors within. However, the Drawings do not show all of the necessary conduit bends. Install conduits in such a manner as to conform to structure, avoid obstruction, preserve headroom and keep passageways and openings clear.

C. Locate outlets symmetrically with architectural elements, notwithstanding the fact that the locations shown of the electrical drawings may be distorted for clarity of representation.

D. The architectural Drawings take precedence over the electrical Drawings. Study the reflected ceiling plans and interior elevations to determine the exact location of lighitng fixtures, wall-mounted devices and fixtures, etc. The Architect has taken a very active role in the placement of these items. Should there be a conflict between locations shown on the architectural and electrical drawings, contact the Engineer for clarification prior to rough-in.

E. Before submitting a bid, examine all pertinent Contract Documents for electrical requirements which are not necessarily indicated on the electrical Drawings and include in the bid a sum which is sufficient to cover the costs of these other requirements.

F. Should it be perceived that the Contract Documents do not sufficiently define the required electrical work, contact the Architect for clarification or further description. Failure to do this will be construed as evidence of an understanding of the required electrical systems and their installation.

1.11 REQUESTS FOR INFORMATION (RFIS)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified (refer to Division 1).

1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

2. RFIs shall address single questions and related issues only.

3. All RFIs shall be thoroughly reviewed and approved by the General Contractor and/or Construction Manager for accuracy and need for information required before submittal to Owner’s Design Representative.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.

a. Project number.

b. Date.

c. Name of Contractor.

d. Name of Architect.

e. RFI number, numbered sequentially and unique.

f. RFI subject.

g. Specification Section number and title and related paragraphs, as appropriate.

h. Drawing number and detail references, as appropriate.

i. Field dimensions and conditions, as appropriate.

j. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

k. Contractor's signature.

l. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

1) Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow a minimum three business days for Engineer's response for each RFI, plus additional time for Architect and General Contractor to review and forward. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

a. Incomplete RFIs or inaccurately prepared RFIs.

b. RFIs submitted without indication of review and approval for submission by General Contractor.

c. RFIs addressing multiple unrelated issues.

d. Requests for approval of submittals.

e. Requests for approval of substitutions.

f. Requests for approval of Contractor's means and methods.

g. Requests for information already indicated in the Contract Documents.

h. Requests for adjustments in the Contract Time or the Contract Sum.

i. Requests for interpretation of Engineer's actions on submittals.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

1.12 VERIFICATION OF AVAILABLE SPACE

A. Throughout the course of construction, verify that sufficient space will be available for the equipment to be installed.

1.13 IDENTIFICATION MARKINGS

A. Switchboards, distribution and branch panelboards, terminal cabinets and other miscellaneous electrical equipment shall be identified with laminated black and white engraved plastic nameplates which properly identify each item. Nameplates shall be attached with steel rivets or bolts and nuts.

1.14 EXISTING FACILITIES

A. Examine the drawings and specifications of the completed work and inspect the site to establish the scope of demolition work and new work to be provided under this sections and clarification of the phasing of the work.

B. Based on project phasing and scheduling, demolition work will be taking place in and around existing areas that are to remain in service. Where the work under this section affects or interferes with the operation of any existing areas to remain in service, or portions of the work already in operation, provide all necessary work and material including premium pay, required to avoid shutdown of these areas during normal operations. Obtain Owner's approval for shutdown, in writing, 48 hours prior to shutdown.

C. Existing electrical and signal facilities outside of the demolition area to remain in place and in service during demolition.

D. Unless specifically noted or otherwise indicated or directed, remove all existing electrical equipment in the areas to be demolished. Deliver all equipment removed, including lighting fixtures, to the Owner's representative.

1.15 REMODELING

A. Where remodeling of existing areas is indicated, provide all work indicated and required for a complete and operating facility. Where work is adjacent to existing fixtures or devices, provide matching products to present uniform appearance. Salvage demolished material and equipment and deliver to Owner as directed. Dispose of salvaged materials and equipment where so directed in writing by Owner. Patch all openings in existing walls or floors caused by removal of materials and/or equipment under this work.

1.16 DEMOLITION

A. Where areas of existing facilities are indicated to be demolished or remodeled, visit site to determine scope of work. Relocate electric and signal system equipment, and reroute or replace conduit and wiring as required to conform with new use of the area and maintain operation of adjacent areas.

1.17 WATERPROOFING

A. Wherever electrical Work pierces waterproofing or waterproofing membranes, install it in an approved watertight manner.

1.18 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect electrical equipment and materials during transit, storage and handling to prevent damage, soiling and deterioration.

B. Provide new electrical materials and deliver them to the Project Site in unbroken packages.

1.19 CUTTING AND PATCHING

A. Provide core drilling, cutting and patching of existing construction and surfaces for the installation of electrical systems. Concrete, asphalt or plaster surfaces which have been damaged by such drilling or cutting shall be patched and repaired to match the surrounding surface.

1.20 ADJUST AND CLEAN

A. Keep the Project Site free from accumulations of electrical rubbish and debris. Remove such accumulations from the Project Site.

B. Thoroughly clean electrical equipment and materials of plaster, cement and other foreign materials and leave smooth, clean and dry.

1.21 FIELD QUALITY CONTROL

A. At project Completion or upon request of the Architect anytime, make necessary tests under the observation of the Architect which will ensure that electrical equipment, materials and installation methods are as specified.

B. At Project Completion, test electrical loads and controls under full operating conditions and immediately replace, at no cost to the Owner, defective electrical equipment, devices and workmanship. Make standard electrical equipment, materials and performance tests and also tests as may be required by the Architect, such as electrical insulation and ground resistance, or temperature rise.

C. Closing-in of Work: Do not allow Electrical Work to be covered or enclosed until it has been observed by the Architect's Representative. Should unobserved Electrical Work be covered or enclosed, uncover it for observation and then make repairs as necessary to restore the Electrical Work and the Work of other affected installers to its original and proper condition, at no cost to the Owner.

PART 2 - - PRODUCTS

2.1 NOT USED.

PART 3 - - EXECUTION

3.1 NOT USED.

END OF SECTION

MEDIUM VOLTAGE CABLES

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 cables and related splices, terminations, and accessories for medium-voltage electrical distribution systems.

1.3 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cable indicated. Include splices and terminations for cables and cable accessories.

B. Samples: 16-inch (400-mm) lengths of each type of cable indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each cable and accessory type, signed by manufacturers.

C. Source quality-control test reports.

D. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.

D. 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.

E. Comply with IEEE C2 and NFPA 70.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cables:

a. American Insulated Wire Corp.; a Leviton Company.

b. General Cable Technologies Corporation.

c. Kerite Co. (The); Hubbell Incorporated.

d. Okonite Company (The).

e. Pirelli Cables & Systems NA.

f. Rome Cable Corporation.

g. Southwire Company.

h. Or approved manufacturer.

2. Cable Splicing and Terminating Products and Accessories:

a. Engineered Products Company.

b. G&W Electric Company.

c. MPHusky.

d. Raychem Corp.; Telephone Energy and Industrial Division; Tyco International Ltd.

e. RTE Components; Cooper Power Systems, Inc.

f. Scott Fetzer Co. (The); Adalet.

g. Thomas & Betts Corporation.

h. Thomas & Betts Corporation/Elastimold.

i. 3M; Electrical Products Division.

j. Or approved.

2.2 CABLES

A. Cable Type: MV105.

B. Comply with UL 1072, AEIC CS 8, ICEA S-93-639, and ICEA S-97-682.

C. Conductor: Copper.

D. Conductor Stranding: Compact round, concentric lay, Class B.

E. Strand Filling: Conductor interstices are filled with impermeable compound.

F. Conductor Insulation: Crosslinked polyethylene.

G. Conductor Insulation: Ethylene-propylene rubber.

1. Voltage Rating: 25 kV.

2. Insulation Thickness: 133 percent insulation level.

H. Shielding: Copper tape, helically applied over semiconducting insulation shield.

I. Shielding and Jacket: Corrugated copper drain wires embedded in extruded, chlorinated, polyethylene jacket.

J. Three-Conductor Cable Assembly: Three insulated, shielded conductors cabled together with ground conductors.

1. Circuit Identification: Color-coded tape (black, red, blue) under the metallic shielding.

K. Cable Armor: Interlocked aluminum applied over cable.

L. Cable Jacket: Sunlight-resistant PVC.

2.3 SPLICE KITS

A. Connectors and Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for the application.

B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.

1. Combination tape and cold-shrink-rubber sleeve kit with rejacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.

2. Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket.

3. Premolded, cold-shrink-rubber, in-line splicing kit.

4. Premolded EPDM splicing body kit with cable joint sealed by interference fit of mating parts and cable.

2.4 SOLID TERMINATIONS

A. Multiconductor Cable Sheath Seals: Type recommended by seal manufacturer for type of cable and installation conditions, including orientation.

1. Compound-filled, cast-metal body, metal-clad cable terminator for metal-clad cable **with** external plastic jacket.

2. Cold-shrink sheath seal kit with preformed sleeve openings sized for cable and insulated conductors.

3. Heat-shrink sheath seal kit with phase- and ground-conductor rejacketing tubes, cable-end sealing boot, and sealing plugs for unused ground-wire openings in boot.

4. Cast-epoxy-resin sheath seal kit with wraparound mold and packaged, two-part, epoxy-resin casting material.

B. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.

2. Class 2 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, and compression-type connector. Include silicone-rubber tape, cold-shrink-rubber sleeve, or heat-shrink plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.

3. Class 3 Terminations: Kit with stress cone and compression-type connector.

C. Nonshielded-Cable Terminations: Kit with compression-type connector. Include silicone-rubber tape, cold-shrink-rubber sleeve, or heat-shrink plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.

2.5 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

C. Load-Break Cable Terminators: Elbow-type units with 200-A load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

D. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

E. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless-steel mounting brackets, and attaching hardware.

1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.

2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.

3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.

4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

F. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

G. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.6 ARC-PROOFING MATERIALS

A. Tape for First Course on Metal Objects: 10-mil- (250-micrometer-) thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch (8 mm) thick, compatible with cable jacket.

C. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1/2 inch (13 mm) wide.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect cables according to ICEA S-97-682 before shipping.

B. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig (35 kPa).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cables according to IEEE 576.

B. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.

2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.

C. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

D. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

E. Install direct-buried cables on leveled and tamped bed of 3-inch- (75-mm-) thick, clean sand. Separate cables crossing other cables or piping by a minimum of 4 inches (100 mm) of tamped earth. Install permanent markers at ends of cable runs, changes in direction, and buried splices.

F. Install "buried-cable" warning tape 12 inches (305 mm) above cables.

G. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.

H. Install cable splices at pull points and elsewhere as indicated; use standard kits.

I. Install terminations at ends of conductors and seal multiconductor cable ends with standard kits.

J. Install separable insulated-connector components as follows:

1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.

2. Portable Feed-Through Accessory: Three.

3. Standoff Insulator: Three.

K. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:

1. Clean cable sheath.

2. Wrap metallic cable components with 10-mil (250-micrometer) pipe-wrapping tape.

3. Smooth surface contours with electrical insulation putty.

4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.

5. Band arc-proofing tape with 1-inch- (25-mm-) wide bands of half-lapped, adhesive, glass-cloth tape 2 inches (50 mm) o.c.

L. Seal around cables passing through fire-rated elements according to Division 07 Section "Penetration Firestopping."

M. Install fault indicators on each phase where indicated.

N. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

O. Identify cables according to Division 26 Section "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

C. Perform the following field tests and inspections and prepare test reports:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.

2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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 the following:

1. Building wires and cables rated 600 V and less.

2. Connectors, splices, and terminations rated 600 V and less.

3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-dieneterpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.5 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. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable Corporation.
2. Southwire Company.
3. Rome
4. Anaconda-Erickson
5. Okonite
6. General electric
7. Excell

B. Conductor Material:

1. Copper complying with NEMA WC 5 or 7.
2. Aluminum material not allowed.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.

D. Multiconductor Cable: Armored cable, Type AC; Metal-clad cable, Type MC; Type SO. All multiconductor cables shall have full sized green insulated copper ground wire. Wiring methods without green ground wire are not approved as equal, special permission and approval by engineer is required. MC cable is not allowed for general use and is only allowed as approved by owner.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. 3M; Electrical Products Division.
2. Buchanan

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Molded connectors with metal thread-on core shall be used for splicing 14, 12 and 10 wire.

2.3 WIRE PULLING LUBRICANT

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Polywater

2. Aqua Gel (clear)

3. NO Ideal 77 Yellow

2.4 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings:

1. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.

2. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATION

A. Feeders: Copper, stranded for No.14 AWG and larger.

1. Solid copper conductors are not allowed.

B. Branch Circuit: Copper No.14 AWG and larger.

1. Solid copper conductors are not allowed.

C. Aluminum conductors are not allowed.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders and Homeruns Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders and Homeruns Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Exposed Branch Circuits: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, Crawlspaces and Partitions: Type THHN-THWN, single conductors in raceway. Type MC and AC cables are not allowed in walls and not approved for homeruns to power panels.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

H. Branch circuits to lighting and vibrating equipment: Type MC and AC.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conductors pulled shall not exceed 40% of conduit area.

B. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Oil and grease shall not be used to lubricate wires. Do not exceed manufacturer's recommended sidewall pressure values.

D. Do not exceed cable pulling tensions and bending radius as specified by the cable manufacturer.

E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway. Avoid kinking or abrasion to the insulation.

F. Couplings and conduit connectors shall have pre-insulated bushings in place before pulling wires.

G. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

H. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

I. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

J. A dedicated neutral conductor shall be provided for all single pole circuits.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

END OF SECTION

GROUNDING AND BONDING FOR ELECTRICAL 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 SUMMARY

A. Section Includes: Grounding systems and equipment.

B. Section includes grounding systems and equipment, plus the following special applications:

1. Underground distribution grounding.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

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. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 3/0 for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.

2. Lighting circuits.

3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.

7. Armored and metal-clad cable runs.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.

3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

C. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.5 LABELING

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1ohm(s).

5. Substations and Pad-Mounted Equipment: 5 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL 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 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

B. QUALITY ASSURANCE

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. ERICO International Corporation.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut; Tyco International, Ltd.

g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. Fabco Plastics Wholesale Limited.

d. Seasafe, Inc.

3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

4. Fitting and Accessory Materials: Same as channels and angles.

5. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Hilti Inc.

      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

      3) MKT Fastening, LLC.

      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cooper B-Line, Inc.; a division of Cooper Industries.

      2) Empire Tool and Manufacturing Co., Inc.

      3) Hilti Inc.

      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

RACEWAYS AND BOXES FOR ELECTRICAL 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 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal auxiliary gutters.
4. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Division 27 Section "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
2. Division 28 Section "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit

J. ARC: Aluminum rigid conduit.

K. GRC: Galvanized rigid steel conduit.

L. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals: "Product Data for Credit IEQ 4.1" Subparagraph below applies to LEED-NC, LEED-CI, and LEED-CS; coordinate with requirements for solvent cements and adhesive primers.

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content."Laboratory Test Reports for Credit IEQ 4" Subparagraph below applies to LEED for Schools.

2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Allied Tube & Conduit; a Tyco International Ltd. Co.

3. Anamet Electrical, Inc.

4. Electri-Flex Company.

5. O-Z/Gedney; a brand of EGS Electrical Group.

6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.

7. Robroy Industries.

8. Southwire Company.

9. Thomas & Betts Corporation.

10. Western Tube and Conduit Corporation.

11. Wheatland Tube Company; a division of John Maneely Company.

12. Or approved.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.

2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT:

a. Material: Steel.

b. Type: compression.

2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Anamet Electrical, Inc.

3. CANTEX Inc.

4. Electri-Flex Company.

5. Kraloy.

6. Lamson & Sessions; Carlon Electrical Products.

7. RACO; a Hubbell company.

8. Thomas & Betts Corporation.

9. Or approved.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. RTRC: Comply with UL 1684A and NEMA TC 14.

G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Fittings for LFNC: Comply with UL 514B.

I. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

J. Solvent cements and adhesive primers 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."

2.3 METAL AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.

2. Hoffman; a Pentair company.

3. Mono-Systems, Inc.

4. Square D; a brand of Schneider Electric.

5. Or approved.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Technologies Company; Cooper Crouse-Hinds.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman; a Pentair company.
5. Hubbell Incorporated; Killark Division.
6. Kraloy.
7. Milbank Manufacturing Co.
8. Mono-Systems, Inc.
9. O-Z/Gedney; a brand of EGS Electrical Group.
10. RACO; a Hubbell Company.
11. Robroy Industries.
12. Spring City Electrical Manufacturing Company.
13. Thomas & Betts Corporation.
14. Wiremold / Legrand.
15. Or approved.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Semi-adjustable.

3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

L. Gangable boxes are allowed.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Plastic.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.

2. Concealed Conduit, Aboveground: GRC.

3. Underground Conduit: RNC, Type EPC-40-PVC.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: EMT.

3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

a. Loading dock.

b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: GRC.

7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic damp or wet locations.

C. Minimum Raceway Size: 1/2-inch (16-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. A. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

R. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.

3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittingsRetain "Expansion-Joint Fittings" Paragraph below unless locations for expansion fittings for RNC are indicated on Drawings. See Evaluations.

V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.

X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a rain tight connection between box and cover plate or supported equipment and box.

Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Z. Locate boxes so that cover or plate will not span different building finishes.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

DD. All control boxes and panels are to have hinged covers with door-in-door panels.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Division 31 Section "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install 90 degree rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Division 26 Section "Identification for Electrical Systems."

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL 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 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

B. Related Sections include the following:

1. Division 26 Section "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: B.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
    a. Component Importance Factor: 1.0.
    b. Component Response Modification Factor: 1.5.

c. Component Amplification Factor: 1.0.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.

a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.

3. Field-fabricated supports.

4. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.

c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Qualification Data: For testing agency.

C. Welding certificates.

D. Field quality-control test reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.

2. Amber/Booth Company, Inc.

3. California Dynamics Corporation.

4. Isolation Technology, Inc.

5. Kinetics Noise Control.

6. Mason Industries.

7. Vibration Eliminator Co., Inc.

8. Vibration Isolation.

9. Vibration Mountings & Controls, Inc.

10. Or approved.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.

2. California Dynamics Corporation.

3. Cooper B-Line, Inc.; a division of Cooper Industries.

4. Hilti Inc.

5. Loos & Co.; Seismic Earthquake Division.

6. Mason Industries.

7. TOLCO Incorporated; a brand of NIBCO INC.

8. Unistrut; Tyco International, Ltd.

9. Or approved.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for

exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.

2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in 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.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.

6. Measure isolator restraint clearance.

7. Measure isolator deflection.

8. Verify snubber minimum clearances.

9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

VIBRATION ISOLATION OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SCOPE

A. Install electrical equipment and conduit in a manner to prevent transmission of objectionable vibration to acoustically critical/sensitive spaces. Vibration isolation includes, but is not limited to, resilient mounting of transformers, racks containing fans or transformers (dimmers, amplifiers, datacom, etc.) and use of flexible conduit.

1.2 RELATED WORK

A. Perform work described in other Specification Sections to meet the product and execution requirements of this Specification.

1. Division 1 – General Requirements.

2. Section 01 86 36 – Ambient Noise Performance Requirements.

3. All Division 22, 23, 26, 27 specifications relating to vibration isolated equipment and materials.

1.3 QUALITY ASSURANCE

A. Provide vibration isolators for Divisions 22, 23, 26, 27 from the product line of a single manufacturer unless approved by the project Acoustics Consultant. **Isolators not supplied by the primary vibration isolator manufacturer will be rejected.**

B. The vibration isolator manufacturer's representative shall determine isolator sizes and mountings, and shall provide field supervision and inspection to assure proper installation, adjustment and performance. Representative shall alert the Engineer and project Acoustics Consultant to any isolator selections, which may experience resonance with the approved equipment and upgrade any isolators that are found to resonate with the supported equipment. The Contractor shall include in his bid vibration isolation system elements as recommended by the manufacturer's representative to make a complete, correct, and safe installation. Supply and install any incidental materials needed, even if not explicitly specified or shown in the Construction Documents, without claim for additional payment.

C. A licensed professional engineer, in the employ of the vibration isolation manufacturer, shall certify and stamp the shop drawings stating that all requirements of state and local codes have been met.

1.4 SUBMITTALS

A. Vibration Isolation Mounts and Hangers: In a single consolidated submittal, provide catalog datasheets, shop drawings and other documents as necessary to indicate equipment unit number, isolator type, supported weight, scheduled deflection, and **proposed deflection under operating load** for each isolator. **Partial and/or incomplete submittals will be rejected**. Indicate bridge bearing quality and durometer for elastomers where provided. Use the format below to summarize isolator characteristics for submittal review by the Engineer and project Acoustics

Consultant.

B. **SAMPLE SUBMITTAL FORMAT**:

	MOUNT/HANGER
Supported Equipment	T-1
Isolator Type	ND-B-Green
Supported Weight	135 LB
Operating Deflection	**0.36 inch**
Remarks	40 durometer

C. Inspection Report: Upon completion of the installation and after the system is put into operation, the manufacturer's representative shall make a final inspection and submit his report to the Architects and Engineers in writing certifying the correctness of installation and compliance with approved submittal data. The Contractor shall allow for the cost of this service in his bid.

PART 2 PRODUCTS

2.1 FLEXIBLE STEEL CONDUIT

A. Flexible steel conduit shall be in accordance with Section 26 05 34 – Conduit.

2.2 FLEXIBLE CONDUIT CONNECTORS

A. Flexible conduit connectors for conduit sizes greater than 2” diameter shall be Crouse-Hinds type XD expansion/deflection coupling.

2.3 VIBRATION ISOLATION MANUFACTURERS

A. The following vibration isolation manufacturers will be approved providing mounting systems are in strict accordance with design intent as specified herein:

1. Mason Industries, Inc., Hauppauge, New York.
2. Kinetics Noise Control, Dublin, Ohio.
3. The VMC Group / Amber-Booth Company, Inc., Houston, Texas.
4. The VMC Group / Korfund Dynamics, Bloomingdale, NJ.

B. Since manufacturers’ products vary, specific models listed in this Specification may not be approved if they do not meet all requirements in this Specification. Model designations listed herein are intended only as a guide.

2.4 CORROSION RESISTANCE

A. All isolators and associated hardware shall be designed or treated for resistance to corrosion.

2.5 ELASTOMER REQUIREMENTS

A. All elastomeric (rubber, neoprene) components shall be selected for lowest durometer available, Shore A rating. Hardness shall not exceed 50 durometer, Shore A rating, unless approved by project Acoustics Consultant. Use bridge-bearing quality rubber or neoprene meeting AASHTO Highway Bridge Specifications in all elastomeric components.

2.6 TYPE B: ELASTOMER-IN-SHEAR FLOOR MOUNT ISOLATORS

A. Elastomer in shear floor mount isolators shall have steel bottom plates with bolt holes, threaded steel insert at top of the mounting, and friction surfaces both top and bottom. Mason model ND, Kinetics model RD, Amber-Booth model RVD, Korfund model RD.

2.7 TYPE F: ELASTOMERIC HANGERS

A. Elastomeric hangers shall be an elastomer-in-shear element mounted in a hanger box. The diameter of the hole in the hanger box shall allow for 15-degree misalignment from vertical before mechanical short circuit occurs. Mason model HD, Kinetics model RH, Amber-Booth model BRD, Korfund model RHD.

2.8 TYPE K: SWAY BRACES

A. Sway braces shall be in sets of two or more and shall consist of aircraft cable, elastomers, or elastomer and spring assemblies. Braces shall keep the equipment stable without restricting the free motion of the vibration isolators.

2.9 TYPE P: CAPTIVE ELASTOMER WALL MOUNT ISOLATORS

A. Captive elastomer wall mount isolators shall contain an elastomer captured by a metal housing to provide restraint in all directions. Mason model BR, Kinetics model RQ, Korfund model MB.

2.10 VIBRATION ISOLATION TABLE (TABLE 1)

A. Vibration isolation for all equipment shall be provided in accordance with the following Table 1, within rated capacities of isolators, except as otherwise noted in Part 3 of this Specification.

TABLE 1: VIBRATION ISOLATION TABLE

EQUIPMENT TAG	ISOLATOR TYPE	MIN. OPERATING DEFLECTION (IN.)
Floor-Mounted Transformers	B	0.16
Suspended Transformers	F	0.20

Floor-Mounted Racks Containing Transformers and/or Fans	B	0.16
Wall-Mounted Racks Containing Transformers and/or Fans	P	0.05

PART 3 EXECUTION

3.1 INSTALLATION

A. Mount all transformers and equipment racks containing fans and/or transformers (dimmers, amplifiers, datacom, etc.) on vibration isolators per Table 1. Install equipment to avoid rigid connection between isolated equipment and structure.

3.2 FLEXIBLE CONDUIT

A. Use flexible conduit for all connections to equipment that requires vibration isolation per the Contract Documents. Flexible conduit shall be a minimum length of 12” with 25% greater length than the separation between the isolated equipment and the termination of rigid conduit. Install the flexible conduit to be slack and not to exceed the manufacturer's minimum recommended bending radius. For conduit sizes greater than 2” diameter, use pre-manufactured flexible conduit connectors instead of flexible conduit.

3.3 TRANSFORMERS

A. For all transformers, main feed must be attached to the side or top of the transformer. Under no circumstances shall the Contractor connect the feed to the bottom of the transformer without obtaining written approval from the project Acoustics Consultant.

END OF SECTION

IDENTIFICATION FOR ELECTRICAL 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 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on a white field.

2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.

2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high letters on 20-inch (500-mm) centers.

D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stop stripes at legends.

F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Black letters on a white field.

2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.

2. Punched or drilled for mechanical fasteners.

3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black except where used for color-coding.

B. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).

3. UL 94 Flame Rating: 94V-0.

4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).

5. Color: Black.

2.9 PANELBOARD, DISTRIBUTION AND MCC IDENTIFICATION

A. Circuit Numbering: Provide factory-supplied permanent self-adhesive labels to identify each pole of all panelboards.

B. Nameplates: Provide nameplates per above section: "Nameplates, Labels, Signs, and Instruction Plates."

C. Schedule Holder: Provide crystal clear, heavy duty, 5 1/8" x 81/2" vinyl, long side open. Storesmart #STB897 peel and stick 8GA. Vinyl or approved equal.

2.10 DEVICE COVERPLATE LABELS

A. Coverplate material shall be as specified in Section 262726: Coverplates.

B. Embossed metallic or plastic tape (Dymo) is not acceptable for any application.

C. Methods of Inscription: (Unless otherwise noted)

1. Self-adhesive Tape: For Imprinted or thermal transfer characters onto permanent water-proof tape lettering system. (Brother's or Kroy). Apply Matte finish spray coating (Krylon #1311) as required to make lettering waterproof.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

I. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Standby Power.

2. Power.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service conductors.

a. Color shall be factory applied.

b. Colors for 208/120-V Circuits:

1) Phase A: Black.

2) Phase B: Red.

3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.

2) Phase B: Orange.

3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

F. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.

3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.

b. Controls with external control power connections.

H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

I. Standby Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

c. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Switchboards.

e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

f. Emergency system boxes and enclosures.

g. Enclosed switches.

h. Enclosed circuit breakers.

i. Enclosed controllers.

j. Variable-speed controllers.

k. Push-button stations.

l. Power transfer equipment.

m. Contactors.

3.3 ARC FLASH HAZARD LABELS

A. Arc flash labels shall be orange for PPE levels 0 through 4.

B. Arc flash labels shall be red for a dangerous hazard risk category.

C. The portion of the arc flash hazard label that contains the hazard risk category information shall be color coded as follows:

1. Hazard risk category 0: Green

2. Hazard risk category 1: Yellow

3. Hazard risk category 2: Tan

4. Hazard risk category 3: Orange

5. Hazard risk category 4: Pink

6. Hazard risk category 5: Red

D. Shall meet the requirements of NFPA & 2009 ANSI/NETA Standard for maintenance testing specifications: chapter 6, Power system studies.

E. See spec section 260573 – Over-current protection device coordination study and arc flash hazard analysis, for additional requirements.

3.4 PANELBOARD, DISTRIBUTION AND MCC IDENTIFICATION

A. Circuit Numbering: Starting at the top, odd numbered circuits in sequence down the left hand side and even numbered circuits down the right hand side.

B. Panelboard Nameplates: Mount nameplates with black Bakelite, white letters fastened with sheet metal screws. In finished public areas, such as in lobby or corridor walls, mount the nameplate to the top of the inside of the inner door then also provide an additional 0.75" high, single-line, white nameplate with black 1/4" high panelboard name. All nameplates that are to be mounted on the outside shall be centered, ½" up from the top on the inner door on the outside of the outer door.

C. Panelboard Schedule Holder: Mount schedule holder, secured to inside face of inner panel door. Contractor shall install construction panel schedules in holders during construction and replace with “as of record” panel schedules in holder at end of project. Final schedules shall include

room numbers and explicit description and identification of items controlled by each individual breaker.

3.5 DEVICE COVERPLATE LABELS

A. Provide self-adhesive type labels for all receptacles, switches, outlets, plugmold, etc. per the following:

1. Lettering Type: Helvetica, 1/4" high.

2. Text: Label coverplates with identity of source and circuit number serving the device per the following convention: “Panel Name”- “Circuit Numbers” (except UPS circuits, which have word UPS as part of the label). Example: “MTE0032-1”, “UPS MTE0033-3”.

3. Color of Characters shall be as follows:

Text Color	Background Color	System Description
Black	White	Normal power devices coverplates

4. Installation of self-adhesive tape:

a. Imprinted tape shall be coated with a permanent, non-gloss protective finish. Spray coating shall be applied prior to installation or simultaneously as with Brother’s unit.

b. Tape shall be applied to coverplate there is no need to wrap label and label should be at bottom of plate. Top of plate for special equipment designations.

c. Inscription shall be centered and square with coverplate.

B. Provide engraved coverplates for switches, dimmers, etc. as follows: (in addition to panel-circuit number labels)

1. All multi-ganged (three or more) switches or dimmers.

2. All special purpose switches or controls, i.e. - fan, projector screen, etc. where it is not obvious what it controls.

3. Engraving shall indicate fixtures or devices controlled (i.e. "Down Lights", "Cove Lights", etc.)

C. Switch cover plates that control various systems (AV, projection screens, etc.) shall be labeled with 1/8” black lettering indicating the function.

3.6 GROUND CONDUCTOR

1. Label ground conductors at main ground bar.

2. No. 6 and larger are to be identified at accessible points per NEC.

END OF SECTION

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

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 computer-based, Arc flash hazard analysis, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.

2. Study and Equipment Evaluation Reports.

3. Coordination-Study Report.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For coordination-study specialist.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide Insert computer software developer's name; product name or designation or a comparable product by one of the following:

1. CGI CYME.

2. EDSA Micro Corporation.

3. ESA Inc.

4. Operation Technology, Inc.

5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.

b. Simultaneous faults.

c. Explicit negative sequence.

d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination and arc flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Impedance of utility service entrance.

3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

a. Circuit-breaker and fuse-current ratings and types.

b. Relays and associated power and current transformer ratings and ratios.

c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.

d. Generator kilovolt amperes, size, voltage, and source impedance.

e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.

f. Busway ampacity and impedance.

g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.

b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.

d. Generator thermal-damage curve.

e. Ratings, types, and settings of utility company's overcurrent protective devices.

f. Special overcurrent protective device settings or types stipulated by utility company.

g. Time-current-characteristic curves of devices indicated to be coordinated.

h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchgear and switchboard bus.

2. Medium-voltage controller.

3. Distribution panelboard.

4. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.

1. Transformers:

a. ANSI C57.12.10.

b. ANSI C57.12.22.

c. ANSI C57.12.40.

d. IEEE C57.12.00.

e. IEEE C57.96.

2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.

3. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.

2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.

3. Calculate the maximum and minimum ground-fault currents.

4. Time-current curves to comply with U of O standards of .1 second for Normal power systems and .01 seconds for Standby systems.

B. Comply with IEEE 141 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.

b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.

c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag.

b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.

d. Fuse-current rating and type.

e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.

b. Voltage and current ratio for curves.

c. Three-phase and single-phase damage points for each transformer.

d. No damage, melting, and clearing curves for fuses.

e. Cable damage curves.

f. Transformer inrush points.

g. Maximum fault-current cutoff point.

F. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in the NFPA70E- 2004 annex D.

B. The flash protection boundary and incident energy shall be calculated at all significant locations in the electrical distribution system, (switchboards, switchgear, motor control centers panelboards, busway and splitters) where work could be performed on energized parts.

C. The Arc-Flash Hazard analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated flash boundary considering an incident energy of 1.2 cal/cm^2.

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume the maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility where applicable.

G. The incident energy calculation must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motor should not be considered beyond 3-5 cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals and the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute in incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2 where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.]

3.6 ARC FLASH WARNING LABELS

A. Provide arc flash hazard labels per Campus Standards. The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed. No paper labels.

B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated into the system.

C. The label shall include the following information, at a minimum:

1. Location designation

2. Nominal voltage

3. Flash protection boundary

4. Hazard risk category

5. Incident energy

6. Working distance

7. Engineering report number, revision number and issue date

D. Labels shall be machine printed, with no field markings.

E. Arc flash labels shall be provided in the following manner and all labels shall be based on the recommended overcurrent device settings.

1. For each 600, 480 and applicable 208 volt panelboard, one arc flash label shall be provided.

2. For each motor control center, one arc flash label shall be provided.

3. For each low voltage switchboard, one arc flash label shall be provided.

4. For each switchgear, one flash label shall be provided.

5. For medium voltage switches one arc flash label shall be provided.

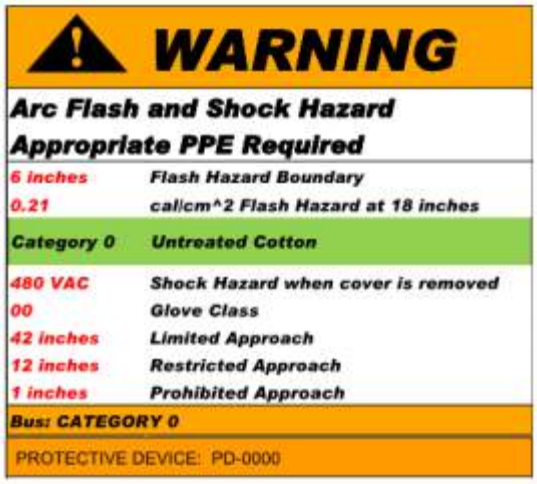
F. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

G. The overall color of the arc flash hazard label shall be orange for PPE levels 0 thru 4.

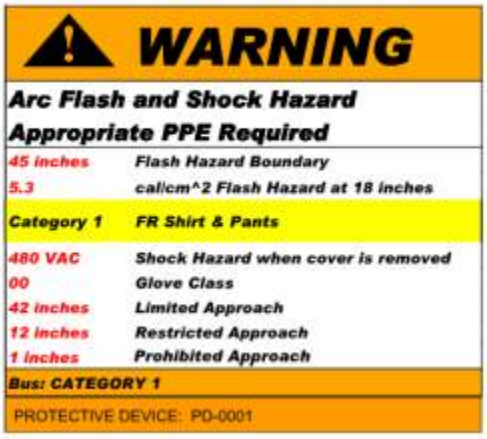
H. The overall color of the arc flash hazard label shall be red for a dangerous hazard risk category.

I. The portion of the arc flash hazard label that contains the hazard risk category information shall be color coded as follows: (Refer to the following sample arc flash hazard labels where the upstream over current protective device has no adjustable settings.)

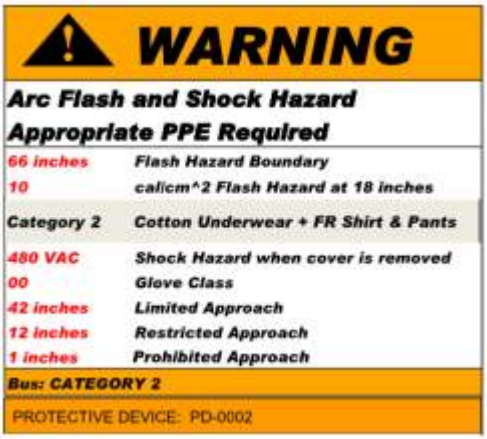
1. Hazard risk category 0: Green.



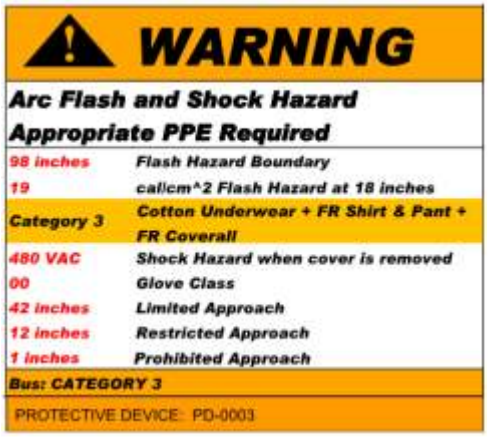
2. Hazard risk category 1: Yellow.



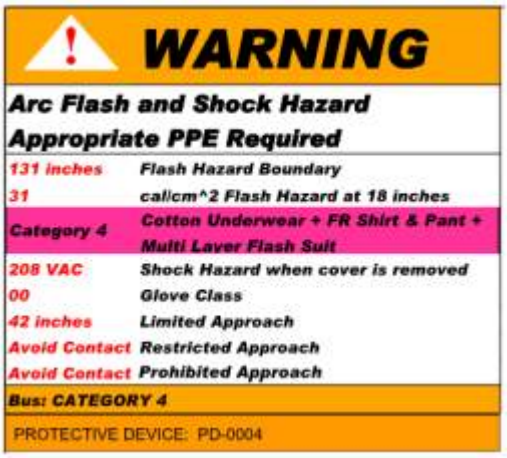
3. Hazard risk category 2: Tan.



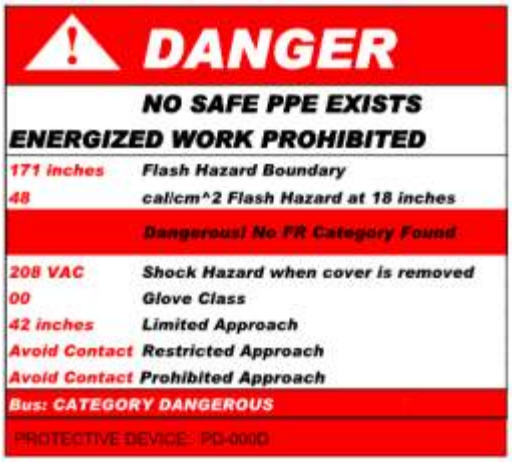
4. Hazard risk category 3: Orange.



5. Hazard risk category 4: Pink.



6. Dangerous: Red.



END OF SECTION

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 COMMISSIONING AUTHORITY

A. The commissioning authority (CxA) has been contracted directly with the owner for this project. The CxA has overall responsibility for planning and coordinating the commissioning process. However, commissioning involves all parties involved with the design and construction process, including the Electrical (Division 26) contractor, as many HVAC system components require electrical power, low voltage, fire alarms and controls in order to operate as specified.

1.2 CONTRACTOR RESPONSIBILITY

A. The Electrical (Division 26) contractor's responsibilities are defined in Section 01 9113, "Commissioning Requirements" of the specifications. Each subcontractor and supplier within Division 26 shall review Section 01 9113, and their bids shall include for carrying out the work described, as it applies to each section within the Division 26 specifications, individually and collectively.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

LIGHTING CONTROL DEVICES

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. Indoor photoelectric switches.
2. Standalone daylight-harvesting switching controls.
3. Indoor occupancy sensors.
4. Lighting contactors.

B. Related Requirements:

1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lutron.

B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present (target level).

b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.

b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.

3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.

4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).

2.2 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lutron Electronics Co., Inc.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Retain subparagraphs below to specify various types of units required for Project.

2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

4. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.

5. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

6. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box.

   b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

7. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

8. Bypass Switch: Override the "on" function in case of sensor failure.

9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.3 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Eaton Corporation.
4. General Electric Company; GE Consumer & Industrial - Electrical Distribution; Total Lighting Control.
5. Square D; a brand of Schneider Electric.
6. or approved.

B. Description: Electrically operated and electrically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Revise subparagraphs below, if required, for specific ratings; or indicate on Drawings. Coordinate control voltage with lighting control system if used. See Evaluations for suggested options to be indicated on Drawings.
2. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
3. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
4. Enclosure: Comply with NEMA 250.
5. Provide with control and pilot devices as scheduled, matching the NEMA type specified for the enclosure.

2.4 OUTDOOR PHOTOCELL

A. Description: Solid state, with SPS dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.

3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.

4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.5 INDOOR PHOTOCELL

A. Application:

1. Provide closed loop type that measures total light level in the space for classrooms & labs.

2. Provide open loop type for open 3 story space on eastern side of building.

B. Contact input photosensor.

1. Light Level Multi-band Monitoring Range: 1-1400 fc.

2. On setpoint range: 1-850 fc.

3. Input Voltage: 24V

4. Output Voltage: 24V

5. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required.

6. Test mode override with LED status indicator.

7. User adjustable parameters: on setpoint; off setpoint; and off setpoint time delay.

8. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

C. Analog photosensor

1. Lightlevel monitoring range 0-100FC.

2. Input Voltage: 24V

3. Output Voltage: 10V or as required per manufacturer.

4. Programming is not integral to device but is made via system software.

5. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required.

6. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

D. Combination Occupancy Sensor and Photocell

1. As an option, a combination Occupancy Sensor and Photocell in place of the two separate devices where appropriate. Complete coverage and response must be obtained. Device must meet photocell and occupancy sensor device requirements listed in this section.

2.6 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Division 26 Section "Network Lighting Controls."

B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

NETWORK LIGHTING CONTROLS

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 manually operated lighting controls with relays and control module.

B. Section includes manually operated, PC-based, digital lighting controls with external signal source**,** relays and control module.

C. Section includes individually addressable lighting control devices communicating with data-entry and -retrieval devices using DALI protocol.

D. Related Sections:

1. Division 26 Section "Lighting Control Devices" for time clocks, photoelectric sensors, occupancy sensors, and multiple contactors.

1.3 DEFINITIONS

A. BACnet: A networking communication protocol that complies with ASHRAE 135.

B. BAS: Building automation system.

C. DALI: Digital addressable lighting interface.

D. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

F. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

G. PC: Personal computer; sometimes plural as "PCs."

H. Power Line Carrier: Use of radio-frequency energy to transmit information over transmission lines whose primary purpose is the transmission of power.

I. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.

J. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components,, manual switches and plates, and conductors and cables.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.

3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.

2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

B. Field quality-control reports.

C. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On a magnetic media or compact disc, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

1.7 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. Electrically Held Relays: Equal to 10 percent of amount installed for each size indicated, but no fewer than 1 relays.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.

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. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with protocol described in IEC 60929, Annex E, for DALI lighting control devices, wiring, and computer hardware and software.

E. Comply with NFPA 70.

1.9 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of lighting control functions.

2. Coordinate lighting controls with BAS. Design display graphics showing building areas controlled; include the status of lighting controls in each area.

3. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

B. Coordinate lighting control components specified in this Section with components specified in Division 26 Section "Panelboards."

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of software input/output to execute switching or dimming commands.

b. Failure of modular relays to operate under manual or software commands.

c. Damage of electronic components due to transient voltage surges.

2. Warranty Period: Two years from date of Substantial Completion.

3. Extended Warranty Period Failure Due to Transient Voltage Surges: Eight years.

4. Extended Warranty Period for Electrically Held Relays: 10 years from date of Substantial Completion.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of the software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lutron Electronics Co., Inc.

2.2 SYSTEM REQUIREMENTS

A. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.

B. Performance Requirements: Manual switches, an internal timing and control unit, and external sensors or other control signal sources send a signal to a PC-based network-system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits, or routes variable commands to one or more dimmers, for groups of lighting fixtures or other loads.

C. BAS Interface: Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports.

1. Hardwired Points:

a. Monitoring: On-off status.

b. Control: On-off operation.

2.3 CONTROL MODULE

A. Control Module Description: Comply with UL 508 (CAN/CSA C22.2, No. 14); microprocessor-based, networked, control unit; mounted in preassembled, modular relay panel. Low-voltage-controlled, latching-type, single-pole lighting circuit relays shall be prime output circuit devices. Where indicated, a limited number of digital or analog, low-voltage control-circuit outputs shall be supported by control unit and circuit boards associated with relays. Control units shall be capable of receiving inputs from sensors and other sources. Line-voltage components and wiring shall be separated from low-voltage components and wiring by barriers. Control module shall be locally programmable.

2.4 POWER DISTRIBUTION COMPONENTS

A. Modular Relay Panel: Comply with UL 508 (CAN/CSA C22.2, No. 14) and UL 916 (CSA C22.2, No. 205); factory assembled with modular single-pole relays, power supplies, and accessory components required for specified performance.

1. Cabinet: Steel with hinged, locking door.

a. Barriers separate low-voltage and line-voltage components.

b. Directory: Mounted on back of door. Identifies each relay as to load groups controlled and each programmed pilot device if any.

c. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.

2. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type.

a. Low-Voltage Leads: Plug connector to the connector strip in cabinet and pilot light power where indicated.

b. Rated Capacity (Mounted in Relay Panel): 20 A, 125-V ac for tungsten filaments; 20 A, 277-V ac for ballasts.

c. Endurance: 50,000 cycles at rated capacity.

d. Mounting: Provision for easy removal and installation in relay cabinet.

B. Line-Voltage Surge Suppression: Factory installed as an integral part of 120- and 277-V ac, solid-state control panels.

2.5 MANUAL ANALOG SWITCHES AND PLATES

A. Push-Button Switches: Modular, momentary-contact, low-voltage type.

1. Match color specified in Division 26 Section "Wiring Devices."

2. Integral green LED pilot light to indicate when circuit is on.

3. Internal white LED locator light to illuminate when circuit is off.

B. Manual, Maintained Contact, Full- or Low-Voltage Switch: Comply with Division 26 Section "Wiring Devices."

C. Wall-Box Dimmers: Comply with Division 26 Section "Wiring Devices."

D. Wall Plates: Single and multigang plates as specified in Division 26 Section "Wiring Devices."

E. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.6 FIELD-MOUNTED DIGITAL CONTROLS AND PLATES

A. Connection Type: RS-485 protocol, category **5e** UTP cable, using RJ45 connectors. Power shall be from the control unit.

B. Pushbutton Switches: Modular, solid-state, programmable, digital, momentary contact, designed to connect to a microprocessor based control unit as a manual control source.

1. Mounting: Standard single-gang recessed switchbox, using device plates specified in Division 26 Section "Wiring Devices."

2. Multi-Gang Mounting: One to six pushbuttons per gang.

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cables: Stranded copper, complying with UL 83, multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Stranded copper, complying with UL 83, multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

D. Structured Network Digital and Multiplexed Signal Cables: UTP cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5e for horizontal copper cable and with Division 27 Section "Communications Horizontal Cabling."

E. RS-485 Cables:

1. Standard Cable: NFPA 70, Type CM.

a. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.

b. PVC insulation.

c. Unshielded.

d. PVC jacket.

e. Flame Resistance: Comply with UL 1581.

2. Plenum-Rated Cable: NFPA 70, Type CMP.

a. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.

b. Fluorinated ethylene propylene insulation.

c. Unshielded.

d. Fluorinated ethylene propylene jacket.

e. Flame Resistance: NFPA 262, Flame Test.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install wiring in raceways. Minimum conduit size shall be 1/2 inch (13 mm).

1. For power wiring comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables"

2. For digital data transmission and low-voltage (operating at less than 50 V) remote control and signaling cables, comply with Division 26 Section "Control-Voltage Electrical Power Cables"

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

E. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.

G. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:

1. Test for circuit continuity.

2. Verify that the control module features are operational.

3. Check operation of local override controls.

4. Test system diagnostics by simulating improper operation of several components selected by Architect.

E. Lighting controls will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.3 SOFTWARE INSTALLATION

A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting controls. See Division 01 Section "Demonstration and Training."

END OF SECTION

LOW VOLTAGE TRANSFORMERS

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 the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. 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. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Qualification Data: For testing agency.

C. Source quality-control test reports.

D. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. 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.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

D. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting NEMA TP 1, Class 1 efficiency levels when tested according to NEMA TP 2.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.8 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Products.

2. Siemens Energy & Automation, Inc.

3. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.

2. Coil Material: **copper only**.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

2. Coil shall be copper only.

E. Retain paragraph and subparagraph below for custom finish.

F. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

I. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.

2. Transformers shall be low loss type with minimum efficiencies per NEMA TP1 when operated at 35% of full load capacity. Efficiency shall be tested in accord with NEMA TP2.

Single Phase		Three Phase	
kVA	Efficiency	kVA	Efficiency
15	97.7%	15	97.0%

25	98.0%	30	97.5%
37.5	98.2%	45	97.7%
50	98.3%	75	98.0%
75	98.5%	112.5	98.2%
100	98.6%	150	98.3%
167	98.7%	225	98.5%
250	98.8%	300	98.6%
333	98.9%	500	98.7%
		750	98.8%.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions**,** seismic codes applicable to Project**,** and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

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.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.

3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

PANELBOARDS

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. Distribution panelboards.

2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to **SEI/ASCE 7**.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified **and the unit will be fully operational after the seismic event**."

1.5 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.

2. Detail enclosure types and details for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.

4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

E. Arc flash hazard analysis report shall be provided by the manufacturer supplying the equipment.

1. Arc Flash hazard analysis shall be performed to identify the shock hazard and appropriate personnel protective equipment (PPE) required at each switchboard, switchgear, distribution board, motor control center, panelboard, UPS, transformer, etc. in accordance with the following standards:

a. IEEE 1584: IEEE guide for performing arc flash calculations.

b. NFPA 70: National Electric Code. Section 11 0.16 Flash Protection.

c. NFPA 70E: Electrical safety requirements for employee workplaces.

2. Provide written report and table summarizing the incident energy exposure available at every faulted bus.

3. Provide arc flash warning labels for all the equipment evaluated.

4. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides listed in the following. Manual calculations are not acceptable.

5. Shall meet the requirements of 2009 ANSI/NETA Standard for maintenance testing specifications: Chapter 6, Power system studies.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

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. Keys: Six spares for each type of panelboard cabinet lock.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. 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.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).

b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without Owner's written permission.

3. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

5. Finishes:

a. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b. Back Boxes: Same finish as panels and trim.

6. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Main and Neutral Lugs: Mechanical screw lugs.

3. Ground Lugs and Bus-Configured Terminators: Mechanical screw lugs.

4. Feed-Through Lugs: Mechanical screw lugs, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

5. Subfeed (Double) Lugs: Mechanical screw lugs type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

6. Gutter-Tap Lugs: Mechanical screw lugs type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Main breaker required at each panelboard.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Verify fault levels with short circuit study specified in Section 26 05 73.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. Siemens Energy & Automation, Inc.

3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike. Doors to be keyed to CAT 60. Coordinate with owner.

D. Mains: Circuit breaker or Main Lugs only, refer to drawings.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. Siemens Energy & Automation, Inc.

3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Hinged front with concealed hinges; secured with flush latch with tumbler lock; keyed alike. Doors to be keyed to CAT 60. Coordinate with owner.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. Siemens Energy & Automation, Inc.

3. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents. No series rating.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

6. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.

b. Common trip handle for circuits shown as multi-wire branch circuits on the drawings.

c. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

d. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

e. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Mount top of trim 74 inches above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

I. Comply with NECA 1.

J. Circuit breakers serving the fire alarm must have tamper proof device and locked in the “on” position.

K. Torque logs are required at each service and/or distribution location to ensure good connections.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. Retain subparagraph below to require a factory-authorized service representative to assist Contractor with inspections, tests, and adjustments.

2. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

4. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

5. Arc flash hazard analysis shall be performed to identify the shock hazard and appropriate personnel protective equipment (PPE) required at each panelboard in accordance with the following standards:

a. IEEE 1584: IEEE Guide for Performing Arc-Flash Hazard Calculations

b. NFPA 70: National Electric Code

c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces

C. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

F. Report results of tests and inspections in writing. Attach a label or tag to each tested component indicating satisfactory completion of tests.

G. Arc flash hazard analysis report shall be provided by the manufacturer supplying the equipment.

H. Provide arc flash warning labels for all the equipment evaluated. Labels must be UV protected.

I. Studies shall use computer program software. Manual calculations are not acceptable.

3.5 ADJUSTING

A. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

END OF SECTION

WIRING DEVICES

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. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Tamper-resistant receptacles.
4. Weather-resistant receptacles.
5. Snap switches and wall-box dimmers.
6. Wall-switch occupancy sensors.
7. Communications outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).

2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

3. Leviton Mfg. Company Inc. (Leviton).

4. Pass & Seymour/Legrand (Pass & Seymour).

5. Lutron

6. Or approved.

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), CR5362 (duplex).

b. Hubbell; HBL5351 (single), HBL5352 (duplex).

c. Leviton; 5891 (single), 5352 (duplex).

d. Pass & Seymour; 5361 (single), 5362 (duplex).

e. Or approved.

B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; TR8300.

b. Hubbell; HBL8300SGA.

c. Leviton; 8300-SGG.

d. Pass & Seymour; TR63H.

2.4 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type.

1.

2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.

3. Include indicator light that shows when the GFCI has malfunctioned or tripped and no longer provides proper GFCI protection.

4. End of life function by rendering itself incapable of delivering power when the test fails or indicating visually/audibly that the device must be replaced.

5. Reverse line-load miswiring function by denying power to the receptacle face if it is miswired.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; VGF20.

b. Hubbell; GFR5352L.

c. Pass & Seymour; 2095.

d. Leviton; 7590.

e. Or approved.

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; GFTR20.

b. Pass & Seymour; 2095TR.

c. Or approved.

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; CWL520R.

b. Hubbell; HBL2310.

c. Leviton; 2310.

d. Pass & Seymour; L520-R.

e. Or approved.

2.6 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Single Pole:

1) Cooper; AH1221.

2) Hubbell; HBL1221.

3) Leviton; 1221-2.

4) Pass & Seymour; CSB20AC1.

5) Or approved.

b. Two Pole:

1) Cooper; AH1222.

2) Hubbell; HBL1222.

3) Leviton; 1222-2.

4) Pass & Seymour; CSB20AC2.

5) Or approved.

c. Three Way:

1) Cooper; AH1223.

2) Hubbell; HBL1223.

3) Leviton; 1223-2.

4) Pass & Seymour; CSB20AC3.

5) Or approved.

d. Four Way:

1) Cooper; AH1224.

2) Hubbell; HBL1224.

3) Leviton; 1224-2.

4) Pass & Seymour; CSB20AC4.

5) Or approved.

2.7 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

1. 600 W; dimmers shall require no derating when ganged with other devices.

C. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.8 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: Smooth, high-impact thermoplastic.

3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.

4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.9 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Ivory unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Emergency Power System: Red.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.

b. Straighten conductors that remain and remove corrosion and foreign matter.

c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.

2. Verify that dimmers used for fan speed control are listed for that application.

3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.8 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than Three of each size and type.

2. Fuse Pullers: Two for each size and type

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. 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.

E. Comply with NFPA 70.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.

3. Do not proceed with interruption of electric service without Owner's written permission.

4. Comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. Siemens Energy & Automation, Inc.

3. Square D; a brand of Schneider Electric.

4. Or approved.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

5. Hookstick Handle: Allows use of a hookstick to operate the handle.

6. Lugs: Mechanical type, suitable for number, size, and conductor material.

7. Service-Rated Switches: Labeled for use as service equipment.

8. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

5. Or approved.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

5. Hookstick Handle: Allows use of a hookstick to operate the handle.

6. Lugs: Mechanical type, suitable for number, size, and conductor material.

7. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.

2. Long- and short-time pickup levels.

3. Long- and short-time time adjustments.

4. Ground-fault pickup level, time delay, and I^2t response.

F. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

G. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

6. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.

7. Accessory Control Power Voltage: 12-V dc and 24-V dc.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

2. Outdoor Locations: NEMA 250, Type 3R.

3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.

4. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

6. Hazardous Areas if Indicated on Drawings: NEMA 250, Type 7 or Type 9.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

END OF SECTION

VARIABLE FREQUENCY DRIVES (VFD)

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, and Section 260500 - Basic Materials and Methods, and other Sections in Division 26 specified herein.

1.2 SCOPE

A. Furnish complete and operational VFD systems as shown on the plans. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Variable frequency drives (VFDs)

2. Controls and control connections

3. Electrical power connections

1.3 RELATED WORK IN OTHER SECTIONS

A. Section 230500: Basic Materials and Methods

B. Section 230593: Testing, Adjusting and Balancing

C. Section 230900: Controls and Instrumentation

D. Section 232123: Pumps and Hydronic Specialties

E. Section 237315: Dedicated Outside Air Handling Units

F. Division 26: Coordination of interface items between the Mechanical equipment and controls and the Electrical Work specified in Division 26.

1.4 QUALITY ASSURANCE

A. Supplier of VFD shall be solely responsible for assuring that the VFD shall work properly with the motor(s) being controlled. VFD supplier shall provide all materials and labor required to replace motors, bearing, shafts, etc. that may be incompatible with VFD or become damaged by VFD at no additional cost to the owner. VFD supplier shall reimburse Architect and Engineer at their standard hourly rates for their involvement in resolving failures due to their VFDs.

B. Manufacturer shall have a minimum of 15 years experience building similar equipment for controlling the speed for induction motors and at least one hundred successful installations with a variety of VFD sizes and applications.

C. To insure quality and minimize failures the VFD(s) and connected motor(s) shall be by one manufacturer. To reduce the known problem of bearing failures by "fluting" the VFD switching rates shall be 6-8 Khz wherever possible. Manufactured VFDs at switching rates of 12-15 Khz shall be accompanied by an additional extended warranty to cover bearings and motors to a period of ten (10) years. Should it be impossible to provide matched motor and VFD's provide a shaft grounding system for the driven motor. Acceptable manufacturer is Shaft Grounding Systems in Albany, Oregon (Representative: DP&A Sales 541-997-4068) or Aegis Shaft Grounding Ring (www.est-aegis.com/cse).

D. To insure quality and minimize infantile failures at the job site, the VFD shall be burned in at the factory at an ambient of 104°F minimum for at least 8 hours. The VFD shall be operating a dynamometer and the load speed shall be cycled during the test. All optional and special features shall be functionally tested at the factory for proper operation.

E. Codes and Standards: Provide VFDs conforming to the requirements of the latest addition of the following:

1. ANSI/EIA 508Electrical Performance Standards for Television Broadcast Transmitters

2. UL508C. All VFD equipment provided under this section must be labeled as UL508C approved.

3. ANSI/IEEE 518Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources.

4. ANSI/IEEE 519-1992: IEEE Recommended Practices and Requirements for Harmonic Control in Electrical power systems.

5. Motors, MG1 parts 30 & 31.

6. National Electrical Manufacturer's Association (NEMA): ICS 7.0, AC Adjustable Speed Drives.

7. IEC 16800 Parts 1 and 21

1.5 QUALIFICATIONS

A. VFD and options shall be UL listed as a complete assembly. VFD requiring customer supply of external fuses for the VFD to be UL listed is NOT acceptable.

B. The base VFD shall be UL listed for 100 KAIC without the need for input circuit breaker.

C. CE Mark: The VFD shall conform to the European Union Electro Magnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level to ensure the VFD does not emit radiated interference.

1.6 SUBMITTALS

A. Concurrent Facilities review and approval of construction submittals required.

B. Product data on variable frequency drives and related components indicating all features specified.

C. Start up log/check list showing successful operation.

D. Operation and Maintenance data

E. Prior to construction submit for approval the following materials:

1. VFD supplier shall provide reference list showing at least ten years of prior manufacturing experience in production of VFDs and a list of at least twenty successful installations with a variety of VFD sizes and applications.

2. Manufacturer's data, installation instructions, and maintenance and operational instructions for variable frequency drives. Indicate electrical service and special requirements. Include manufacturer's descriptive literature, repair data, and parts listing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Protect units against dirt, water, chemical, and mechanical damage. Do not install damaged units. Remove damaged equipment from site.

1.8 WARRANTY

A. Warranty shall be 24 months from the date of certified start-up.

B. Warranty shall include all parts, labor, travel time, software, software updates, and access tools at no additional cost to the Owner.

C. 24 hour support line shall be available on a toll-free line.

1.9 PRODUCT SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. 24 hour technical support line shall be available on a toll-free line.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: ABB unless reviewed and approved by Facilities Maintenance via Construction Standards Substitution Request.

1. NO third party VFD.

2. NO ‘brand labeled’ VFD.

3. NO packaged VFD.

4. Any substitution must comply with requirements listed below.

5. It is required that the drive manufacturer have an existing sales representative exclusively for HVAC products, with expertise in HVAC systems and controls as well as an independent service organization.

6. The drive manufacturer shall supply the drive and all necessary controls as listed below.

7. The manufacturer shall have been in the production of this type of equipment for a minimum of 20 years.

2.2 GENERAL

A. Furnish a complete VFD as scheduled on the plans. Refer to plans for locations of variable speed controllers. Each fan or pump motor shall have a dedicated VFD unit. All standard and optional features shall be included within the VFD enclosure unless otherwise specified. The VFD enclosure shall be provided to match the environment requirements where the VFD will be mounted and operated. Provide NEMA rated enclosure as required. Provide type 1 NEMA VFD's wherever possible. NEMA 12 VFD's must be provided if the VFD is to be run during construction other than testing or the contractor must have the VFD cleaned by a factory tech. Provide type 12 enclosures where located directly below piping or water source.

B. Variable Frequency Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.

C. VFD to be dedicated variable torque design for specific use with centrifugal loads.

D. Provide completely solid state variable frequency power and logic unit.

E. Speed control to be step-less throughout the range under variable torque load on continuous basis.

F. VFD is to be controlled by DDC.

G. Provide adjustable frequency control with diode bridge/capacity input designed to provide high, constant power factor of 0.95 regardless of load or speed and eliminate SCR line noise.

H. Control shall be suitable for operation in ambient temperatures of 0 to 40 degrees C.

I. VFD shall be factory tested with an AC induction motor 100% loaded and temperature cycled within an environmental chamber at 104°F.

J. VFD drives are to be proofed through user adjustable drive auxiliary output.

K. Drives and motors must be compatible.

2.3 SELF PROTECTION AND RELIABILITY FEATURES

A. Adjustable current limit to 60 to 110% of drive rating

B. Adjustable instantaneous over-current trip

C. Under voltage trip

D. Over temperature trip

E. Short circuit protection phase to phase and phase to ground faults phase rotation insensitive

F. Momentary power loss, more than 17 milliseconds

G. Transient protection against all normal transients and surges in incoming power line

H. Orderly shutdown in event of any of above conditions, drive shall be designed to shut down safely without component failure.

I. Provide visual indication and manual reset

2.4 FEATURES

A. Drive logic shall be microprocessor based. Control logic shall be isolated from power circuitry

B. The free standing VFD assembly shall have a circuit breaker disconnect and be UL 508C listed for use on distribution systems with 22,000 AIC.

C. Minimum user adjustable inputs and outputs:

1. 2 independent analog outputs

2. 3 digital outputs

3. 6 digital inputs

4. ALL are to be independent of the VFD function.

D. Frequency Stability: Output frequency will be held to +0.1% of maximum frequency regardless of load, +10% input voltage change or temperature changes within ambient specification.

E. Built-in digital display on the panel face shall be capable of indicating output frequency, voltage and current and shall provide indication of over current, over voltage, current limit, ground fault, over temperature, input power on, minimum or maximum speed adjustment, power on, fault condition.

F. Start and stop control

G. If applicable, the control circuit transformer will have primary and secondary fusing.

H. Minimum and maximum speed control

I. Adjustable acceleration and deceleration; independently adjustable 10-100 second.

J. Hand-Off auto switch(s)

K. Programmable Auto Restart after power outage.

L. The following disconnect switching is required at a minimum:

1. Safety Disconnect: Does not need to be fused. Shall include an early break auxiliary contact to disable the drive when in the 'Off" position.

2. Service Switch: To be mounted at the 'Safety Disconnect' for an orderly shut-down on control. A label shall be included to read 'NOT and Emergency Shut-Down for VFD'.

M. Remote contacts for fault, and on/off status.

N. Adjustable motor output voltage.

O. Analog output voltage of 0-10 VDC, 4-20 MA proportional to control output frequency.

P. Manual speed control for each motor.

Q. UL listed enclosure is to be completely assembled and tested in an ISO9001 manufacturing facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

R. Provide output filters for all VFD locations more than 25 conductor feet from the motor they serve. Output reactors shall permit VFD to be located up to 350ft from the motors they serve.

S. The VFD shall have an integral 5% impedance line reactor to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD with only one DC reactor shall add AC line reactors. This increased impedance lower harmonic distortion (Vthd) meeting IEEE-519 guidelines.

T. The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV (phase to phase and phase to ground), a capacitor clamp and 5% impedance reactors. MOV to protect against transients that would trip a VFD off line or cause serious damage.

U. VFD shall have the following adjustments:

1. A minimum of 2 PID set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control.

2. The VFD shall have 250 ma of 24 VDC (minimum) auxiliary power and be capable of loop powering a transmitter supplied by others.

3. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.

4. There shall be at least two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer and winter set points, etc.

5. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain set point of an independent process (i.e. valve, dampers, etc.).

6. All set points, process variables, etc. are to be accessible from the serial communications network.

7. The set points shall be set in engineering units and not require a percentage of the transducer input.

8. Allows complete control of a system or process

V. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fireman's control station, the VFD shall operate at an adjustable preset speed. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands) and force the motor to run at the adjustable, preset speed. 'Override Mode' shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation.

W. All VFD shall have EMI / RFI filters. The onboard filters shall allow the VFD assembly to be CE marked and the VFD shall meet product standard EN 61800-3 for the first environment restricted level, and exceed FCC guidelines with motor cables less than 100 feet.

X. All VFD through 50HP shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. Prevents damage to the VFD when the electrical contractor wires the input power to motor terminals.

Y. The VFD shall catch a spinning load in forward and reverse direction

Z. Serial Communications:

1. The VFD shall have an RS-485 port as standard. The standard protocol shall be Modbus, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Optional protocols for LonWorks, BACnet, Profibus, Ethernet, and DeviceNet shall be available. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority. Use of non-certified protocols is not allowed.

2. The VFD shall allow the DDC to control and monitor the drive's digital and analog outputs via the serial interface. This control shall be independent of any other VFD function.

3. The VFD shall include an independent PID loop for customer use. This independent PID loop may be used for cooling tower bypass valve control, chilled water valve control, etc. Both the VFD control PID loop and the independent PID loop shall continue functioning even if the serial communications connection is lost. The VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the connection is lost.

4. Serial communication:

   a. Capabilities shall include, but not be limited to: run-stop control; speed set adjustment; proportional/integral/derivative PID control adjustments; current limit; acceleration and deceleration time adjustments; and lock and unlock the keypad.

   b. 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, with the ability to reset; operating hours, with the ability to reset; drive temperature.

   c. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and output values.

   d. All diagnostic warning and fault information shall be transmitted over the serial communications bus.

   e. Remote VFD fault reset shall be possible.

   f. The following additional status indications and settings shall be transmitted over the serial communications bus: keypad ‘Hand’ or ‘Auto’ selected; bypass selected; the ability to change the PID set point; the ability to force the unit to bypass, IF bypass is specified.

   g. The DDC system shall also be able to monitor if the motor is running in the VFD mode or bypass mode, IF bypass is specified.

AA. OPTIONAL FEATURES: Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL listed by the drive manufacturer as a complete assembly and carry a UL508 label.

1. A complete factory wired and tested bypass system consisting of an output contactor and a bypass contactor. Overload protection and shall be provided in both drive and bypass modes.

2. Door interlocked, and pad-lockable circuit breaker that will disconnect all input power from the drive and all internally mounted options.

3. Fused VFD only disconnect (service switch). Fast acting fuses exclusive to the VFD – fast acting 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. Three contactor bypass schemes are not acceptable.

4. The drive bypass shall provide single-phase motor protection in both the VFD and bypass modes.

5. The following operators shall be provided:

   a. Bypass Hand-Off-Auto.

   b. Drive mode selector.

   c. Bypass mode selector.

   d. Bypass fault reset.

6. The following indicating lights (LED type) shall be provided and a test mode or push to test feature shall be provided:

   a. Power-on (Ready).

   b. Run enable (safeties) open.

   c. Drive mode select damper opening.

   d. Bypass mode selected.

   e. Drive running.

   f. Bypass running.

   g. Drive fault.

   h. Bypass fault.

   i. Bypass H-O-A mode.

   j. Automatic transfer to bypass selected.

   k. Safety open.

   l. Damper opening.

   m. Damper end-switch made.

7. The following relay (form C) outputs from the bypass shall be provided:

   a. System started.

   b. System running.

c. Bypass override enabled.

d. Drive fault.

e. Bypass fault (motor overload or underload, broken belt).

f. Bypass H-O-A position.

8. The digital outputs for the system shall accept 24V or 115VAC (selectable). The bypass shall incorporate internally sourced power supply and not require an external control power source.

9. Customer Interlock Terminal strip. Provide a separate terminal strip for connection to 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 (not functional in Fireman's Override). The remote start/stop contact shall operate in VFD and bypass modes.

10. Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure for fireman's override. Two modes of operation are required:

    a. One mode forced the motor to bypass operation and overrides both the VFD and bypass HO-A switches and forces the motor to operate across the line (test mode). The system will only respond to the digital inputs and motor protections.

    b. The second fireman's override mode remains as above, but will also defeat the overload and single-phase protection for bypass and ignore all keypad and digital inputs to the system (run until destruction).

11. The VFD shall include a 'run permissive circuit' that will provide a normally open contact whenever a run command is provided (local or remote start command in VFD or bypass mode). The VFD system (VFD or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve and-switch. When the VFD system safety interlock (fire detector, freeze-stat, high static pressure switch, etc.) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.

12. Class 20 or 30 (selectable) electronic motor overload protection shall be included.

13. There shall be an internal switch to select manual or automatic bypass.

14. There shall be an adjustable current sensing circuit for the bypass to provide loss of load indication (broken belt) when in the bypass mode.

PART 3 - EXECUTION

3.1 INSTALLATION

A. VFD shall be installed in accordance with applicable codes and manufacturer's written installation instructions.

B. Install on a strut support system

C. VFD not to be mounted inside motor control centers or fan units

D. Each VFD will operate only one motor

E. Verify that mounting surface is ready to receive work. Mount the VFD(s) on the wall or at supports in locations identified on the drawings. Provide a layout drawing of VFD locations to electrical installer.

F. If the disconnect for the equipment powered by the VFD is in a location where it is probable that it will be placed in an off position prior to shutting down the VFD, the contractor is to provide electrical protection for the VFD. This may be in the form of a conduit and wire interlock between disconnect and drive or internal protection integral to the VFD.

G. Coordinate wiring and control with Control Contractor. Control installers shall install all wiring associated with control signals into the VFD and for interlock control wiring between disconnects and VFDs.

H. Electrical installer shall install all line voltage power wiring and conduit from electrical switchgear and from the VFD to the disconnect at the controlled motor. The only exception to this is when the motor and drive are factory installed on a packaged piece of equipment. In that case the wiring from drive to motor is to be installed in the factory to meet the requirements herein. Coordinate with Division 26 work.

I. Line length between VFD and driven motor shall be as short as possible. Line length shall not exceed twenty (20) feet without prior approval from Engineer.

J. Input and output power wiring shall be installed in separate grounded conduit. In addition, control wiring shall be installed in its own separate grounded conduit.

K. Use symmetric motor cable between the VFD and motor, with low inductance shield or conduit, and with all joints joined with bonding straps. MC metal clad 3 phase type cable per NEC 334-1, UL approved, 3 phase conductors and 3 ground conductors. Sheath to be continuous corrugated aluminum. Manufacturer and type to be BICC 2 kV rated Drives Cable, Anixter series 7V, or approved equal.

L. Use cable connectors with 360 degree connections to the armor conduit at both ends of motor cable. Verify electrical path from inverter cabinet entry plate to armor / conduit to motor terminal box.

M. Install an auxiliary high frequency bonding connection for potential equalization between VFD frame and building steel.

N. Unless absolutely necessary do not install disconnect between VFD and connected motor. VFD is to be furnished with a lockable disconnect.

3.2 HARMONIC MEASUREMENT:

A. Perform harmonic measurement at the point where the utility feeds multiple loads (PCC) to verify compliance with the latest version of IEEE 519-1992.

B. Provide a report of the voltage THD and current TDD for Engineer and Facilities Maintenance review prior to substantial completion.

C. Provide labor, materials, and protection as needed to access the test points.

D. The readings shall be taken with all drives and other loads at full load, or as close to this as field conditions allow.

3.3 FIELD QUALITY CONTROL:

A. Prior to installation, manufacturer's representative shall coordinate VFD control interface with the control contractor and verify the intended installation (controls, wiring, etc.) complies with the manufacturer's recommendations.

B. Field Test: Except where initial VFD operation clearly shows the performance meets or exceeds the requirements, test to show compliance. Tests shall be performed by the manufacturer's representative in the presence of the Facilities PM and/or Maintenance Electrician.

3.4 MANUFACTURER'S START-UP SERVICES

A. Comply with manufacturer's instructions for startup.

B. Start up shall be provided under the direct supervision of the manufacturer's representative and factory trained personnel.

C. Certified factory start-up shall be provided for each drive by a factory authorized service center.

D. A certified start-up form shall be filled out for each drive with a copy provided to the Facilities PM, and a copy kept on file at the manufacturer.

E. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify control wiring, verify power wiring, start-up the drive, and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours travel from the jobsite.

F. Carrier Frequency Set-up:

1. Set initial carrier frequency at 2 kHz.

2. Manually raise VFD speed output from 10 Hz to 60 Hz by 10 Hz increments, allowing at least 15 seconds between each adjustment. If excessive motor noise is heard at any speed, raise carrier frequency by 2 kHz increments until motor noise is no longer excessive. Do not set carrier frequency higher than 10 kHz.

3. If excessive motor noise continues to be heard at or below 10 kHz, inform owner. If the motor is provided by the VFD manufacturer, either repair, replace, or provide 5 year extended warranty on the effected motor.

G. Lockout of resonant frequencies:

1. With carrier frequency set per the above specification, manually and slowly raise VFD speed output from 10 Hz to 60 Hz by 1 Hz increments. If excessive motor, frame, or driven load noise is heard at any speed, lock out that frequency.

2. Each frequency skip shall be programmed with as narrow a bandwidth as possible, while still avoiding the most objectionable range of resonant frequencies. Each frequency skip bandwidth shall not exceed 5 Hz without approval by Engineer.

H. Training:

1. Provide 1 hour training session to the owner's representative.

2. Training to include

a. Demonstration of operation of bypass switch and door-mounted disconnect switches. Explain emergency operation.

b. Demonstrate operation of operator keypads for viewing data and setting parameters.

c. Demonstrate operation in manual mode, including setting of specific speeds.

d. Explain the drive parameters that might require operator adjustment.

e. Describe troubleshooting techniques and warranty procedure.

END OF SECTION

INTERIOR 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:

1. Interior lighting fixtures, lamps, and ballasts.

2. Exit signs.

3. Lighting fixture supports.

4. Related Sections:

5. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

6. Division 26 Section "Network Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

7. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

8. DEFINITIONS

B. BF: Ballast factor.

C. CCT: Correlated color temperature.

D. CRI: Color-rendering index.

E. HID: High-intensity discharge.

F. LER: Luminaire efficacy rating.

G. Lumen: Measured output of lamp and luminaire, or both.

H. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.

2. Emergency lighting units including battery and charger.

3. Ballast, including BF.

4. Energy-efficiency data.

5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.

6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.

b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

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.

C. Samples: For each lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:

1. Lamps and ballasts, installed.

2. Cords and plugs.

3. Pendant support system.

D. Installation instructions.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting fixtures.

2. Suspended ceiling components.

3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches (305 mm) of the plane of the luminaires.

4. Ceiling-mounted projectors.

5. Structural members to which suspension systems for lighting fixtures will be attached.

6. Other items in finished ceiling including the following:

a. Air outlets and inlets.

b. Chilled beams.

c. Speakers.

d. Sprinklers.

e. Smoke and fire detectors.

f. Occupancy sensors.

g. Access panels.

h. Perimeter moldings.

B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

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. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

3. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.

4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. "Luminaire Photometric Data Testing Laboratory Qualifications" Paragraph below is to set qualifications for testing laboratories performing testing, in lighting fixture manufacturer's factory, that are creating the photometric data required in "Action Submittals" Article.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

C. 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.

D. Comply with NFPA 70.

E. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

F. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of fixtures for mockups before starting installations.

2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

I. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USE ONLY" and include specific lamp type.

b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.

e. ANSI ballast type (M98, M57, etc.) for HID luminaires.

f. CCT and CRI for all luminaires.

J. BALLASTS FOR LINEAR FLUORESCENT LAMPS

K. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.

2. Designed for type and quantity of lamps served.

3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.

4. Sound Rating: Class A.

5. Total Harmonic Distortion Rating: Less than 10 percent.

6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.

7. Operating Frequency: 42 kHz or higher.

8. Lamp Current Crest Factor: 1.7 or less.

9. BF: 0.88 or higher.

10. Power Factor: 0.95 or higher.

11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

L. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

M. Electronic Programmed-Start Ballasts for T5 and T8 Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.

2. Automatic lamp starting after lamp replacement.

N. Retain "Single Ballasts for Multiple Lighting Fixtures" Paragraph below to require ballasts in some fixtures to serve lamps in other fixtures. Indicate fixture types to which this requirement applies in the Interior Lighting Fixture Schedule on Drawings, and indicate connections on lighting plans.

O. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

P. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.

2. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

3. Dimming Range: 100 to 5 percent of rated lamp lumens.

4. Ballast Input Watts: Can be reduced to 20 percent of normal.

5. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

6. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

Q. BALLASTS FOR COMPACT FLUORESCENT LAMPS

R. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.

2. Automatic lamp starting after lamp replacement.

3. Sound Rating: Class A.

4. Total Harmonic Distortion Rating: Less than 20 percent.

5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.

6. Operating Frequency: 20 kHz or higher.

7. Lamp Current Crest Factor: 1.7 or less.

8. BF: 0.95 or higher unless otherwise indicated.

9. Power Factor: 0.98 or higher.

10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.

b. Charger: Fully automatic, solid-state type with sealed transfer relay.

c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

3. Fluorescent Lamps

C. T8 rapid-start lamps, rated 32 W maximum, Low Mercury, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.

D. T8 rapid-start lamps, rated 17 W maximum, Low Mercury, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.

E. LEDs

F. Light Emitting Diodes: White light output with minimum CRI 65, and color temperature 4000 K, and rated life (70% of light output) of 40,000 hours, minimum. Color light output, state specific spectral power distribution, rated life (70% of light output) of 60,000 hours, minimum. Light output (lumen/watt) to be stated for a complete luminaire (power supply, light source, fixture) not on lab bench momentary test but under normal project-specific operating conditions (temperature, humidity, orientation) and for a published duration of the photometry test after the system has stabilized its light output and heat management. Capability to dim shall be published. Color constancy amongst LEDs shall be published in # of MacAdam ellipses of variation. Photometry for all LED products to follow IES recommendations for testing. All LED products must have a 5 year warranty. Recycling program provided by manufacturer, and availability of spare parts at expected end of life must be stated by manufacturer.

2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm.

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.

2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.

2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION

EXTERIOR 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:

1. Exterior luminaires with lamps and ballasts.

B. Related Sections:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

G. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.

B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.

C. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied as stated in AASHTO LTS-4-M Ice Load Map.

1.5 ACTION SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.

2. Details of attaching luminaires and accessories.

3. Details of installation and construction.

4. Luminaire materials.

5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

   a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

   b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Ballasts, including energy-efficiency data.

7. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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. Anchor-bolt templates keyed to specific poles and certified by manufacturer.

3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.

4. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.

B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.

1.8 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. Lamps: One for every 100 of each type and rating installed. Furnish at least one of each type.

2. Glass and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.

3. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.

1.9 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

C. 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.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

F. Reference U of O Planning Policies and Campus Outdoor Lighting Plans.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.

2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.

3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements provide one of the products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.

2. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

3. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.

2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected from manufacturer's standard catalog of colors.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a. Color: Dark bronze.

O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USES ONLY" and include specific lamp type.

b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.

e. ANSI ballast type (M98, M57, etc.) for HID luminaires.

f. CCT and CRI for all luminaires.

2.3 FLUORESCENT BALLASTS AND LAMPS

A. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.

2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.

B. Ballast Characteristics:

1. Power Factor: 90 percent, minimum.

2. Sound Rating: Class A.

3. Total Harmonic Distortion Rating: Less than 10 percent.

4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.

5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.

6. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.

C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures minus 20 deg F (minus 29 deg C) and higher.

2.4 BALLASTS FOR HID LAMPS

A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.

2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).

3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).

4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

B. Auxiliary, Instant-On, Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent of light output.

2.5 LEDS

A. Light Emitting Diodes: White light output with minimum CRI 65 and color temperature 4000K, and rated life (70% of light output) of 40,000 hours, minimum. Color light output, state specific spectral power distribution, rated life (70% of light output) of 60,000 hours, minimum. Light output (lumen/watt) to be stated for a complete luminaire (power supply, light source, fixture), not on lab bench momentary test but under normal project-specific operating conditions (temperature, humidity, orientation) and for a published duration of the photometry test after the system has stabilized its light output and heat management. Capability to dim shall be published. Color constancy amongst LEDs shall be published in # of MacAdam ellipses of variation. Photometry for all LED products to follow IES recommendations for testing. All LED products must have a 5 year warranty. Recycling program provided by manufacturer, and availability of spare parts at expected end of life must be stated by manufacturer.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."

b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."

c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."

d. IESNA LM-64, "Photometric Measurements of Parking Areas."

e. IESNA LM-72, "Directional Positioning of Photometric Data."

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

COMMUNICATIONS PATHWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This Section includes pathway requirements specifically applicable to the communications sections of this project.

B. Furnish and install communications conduit raceways, boxes, cable trays, innerduct and fittings including:

1. Communications conduit systems.
2. Wireway systems.
3. Surface raceway systems.
4. Telecommunications outlet boxes.
5. Pull box enclosures.
6. Cabinets.
7. Pulltape and duct plugs.
8. Raceway identification banding.

1.2 RELEVANT SECTIONS

A. 27 13 13 Telephone Backbone Cabling

B. 27 13 23 Optical Fiber Backbone Cabling

C. 27 13 33 Category 6A Backbone Cabling

D. 27 15 13 Category 5e Horizontal Cabling

E. 27 70 80 Cable Television Cabling

1.3 SUBMITTALS

A. Provide the manufacturer’s cut sheets, clearly indicating specific products proposed for use, with the bid submission.

1.4 PROJECT RECORD DOCUMENTS

A. Plan drawings showing completions and as-built corrections which indicate type, size, placement, routing, and/or length for raceway and cable tray components; e.g., manholes, hand holes, conduit, wireway, boxes, enclosures, etc.

PART 2 - PRODUCTS

2.1 PRODUCT SUBSTITUTIONS

A. Equivalent product(s) may be considered for substitution for those products specified, however, the equivalent product(s) to be approved and show demonstrated and documented equivalence to the product(s) specified. Documentation to include, but is not limited to: product samples, data sheets, and actual test data. The request for product substitution, and supporting documentation, to be submitted, in writing, prior to submitting the bid. Written approval for product substitution to be submitted with the bid.

2.2 GENERAL

A. Raceways, Boxes, Enclosures, Cable Tray Materials and Equipment: Labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended.

B. The product identification codes used for the Communications Raceways and Boxes in Part 2, Products, are summarized in Table 1.

Table 1 - Product Identification

Product Designation	Product Type
RGS	Rigid galvanized steel
CRS	PVC externally coated RGS
EMT	Galvanized steel tubing
PVC	Polyvinylchloride conduit
ENT	Electrical nonmetallic tubing
LMC	Liquidtight metal conduit
LNC	Liquidtight nonmetal conduit

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. Manufactured products, materials, equipment, and components to be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's specifications and printed instructions.

B. The installation of all system components to be carried out under the direction of qualified personnel. Appearance to be considered as important as mechanical and electrical efficiency. Workmanship to meet or exceed industry standards.

C. Place support for framing, raceways, cable trays, backboards, equipment racks, and cabinets.

3.2 PROTECTION DURING CONSTRUCTION

A. Protect products from the effects of moisture, corrosion, and physical damage during construction. Except during installation activity in a section, keep openings in conduit, tubing, and wireway capped with manufactured seals during construction.

3.3 MINIMUM CONDUIT SIZE

A. 1-inch (25 mm) for aboveground installations unless otherwise indicated on the Drawings.

B. 4-inch (100 mm) for underground applications unless otherwise indicated on the Drawings.

3.4 CONDUIT TYPE TO BE USED

A. Install the following types of circular communications raceway in the locations listed unless otherwise indicated on the Drawings.

1. Interior Dry Locations, Exposed: EMT with set screw fittings.

2. Interior Dry Locations, Concealed (Not Embedded in Concrete): EMT with set screw fittings.

3. Interior Wet Locations: EMT with compression fittings.

4. Exterior, Exposed Including Roof: Rigid steel conduit.

5. Concrete-Encased or Buried Duct Banks:

a. PVC Schedule 40 conduit.

b. Rigid steel conduit when additional protection is required.

6. Flexible Conduit (Interior Exposed):

a. Liquidtight flexible metal conduit for use with copper cable.

b. Liquidtight flexible nonmetallic conduit for use with fiber optic cable.

7. Conduits that are to be used for service entrance conductors shall be either:

a. Concrete encased PVC schedule 40 or

b. Rigid or Intermediate metallic conduit (RMC or IMC)

3.5 RACEWAY IDENTIFICATION BANDING

A. Exposed conduits and wireway, including raceways above lay-in or accessible ceilings, together with associated pull boxes to be banded at intervals of not over 10 feet (2500 mm) and at direction changes. Two-band identification to be different contrasting colors as follows:

Raceway Use	Color
Grounding	Green
Building fire alarm system/voice evacuation	Red
Telecom/data	Yellow
Facility management system (FMS) and general control circuitry	Blue and black
CCTV	White
Building monitoring and security	Gray
Controls (non-FMS)	Brown and white

3.6 GROUNDING

A. Provide ground connections and bonding continuity between raceway and cable tray sections, boxes, enclosures, cabinets, and fittings as required.

END OF SECTION

VIBRATION ISOLATION OF COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SCOPE

A. Install communication equipment and conduit in a manner to prevent transmission of objectionable vibration to acoustically critical/sensitive spaces. Vibration isolation includes, but is not limited to, resilient mounting of transformers, racks containing fans or transformers (dimmers, amplifiers, datacom, etc.) and use of flexible conduit.

1.2 RELATED WORK

A. Perform work described in other Specification Sections to meet the product and execution requirements of this Specification.

1. Division 1 – General Requirements.

2. Section 01 86 36 – Ambient Noise Performance Requirements.

3. All Division 26 and 27 specifications relating to vibration isolated equipment and materials.

1.3 QUALITY ASSURANCE

A. Provide vibration isolators for Divisions 22, 23, 26, 27 from the product line of a single manufacturer unless approved by the project Acoustics Consultant. **Isolators not supplied by the primary vibration isolator manufacturer will be rejected.**

B. The vibration isolator manufacturer's representative shall determine isolator sizes and mountings, and shall provide field supervision and inspection to assure proper installation, adjustment and performance. Representative shall alert the Engineer and project Acoustics Consultant to any isolator selections, which may experience resonance with the approved equipment and upgrade any isolators that are found to resonate with the supported equipment. The Contractor shall include in his bid vibration isolation system elements as recommended by the manufacturer's representative to make a complete, correct, and safe installation. Supply and install any incidental materials needed, even if not explicitly specified or shown in the Contract Documents, without claim for additional payment.

C. A licensed professional engineer, in the employ of the vibration isolation manufacturer, shall certify and stamp the shop drawings stating that all requirements of state and local codes have been met.

1.4 SUBMITTALS

A. Vibration Isolation Mounts and Hangers: In a single consolidated submittal, provide catalog datasheets, shop drawings and other documents as necessary to indicate equipment unit number, isolator type, supported weight, scheduled deflection, and **proposed deflection under operating load** for each isolator. **Partial and/or incomplete submittals will be rejected**. Indicate bridge bearing quality and durometer for elastomers where provided. Use the format below to summarize isolator characteristics for submittal review by the Engineer and project Acoustics

Consultant.

B. **SAMPLE SUBMITTAL FORMAT**:

	MOUNT/HANGER
Supported Equipment	AV-1
Isolator Type	ND-B-Green
Supported Weight	135 LB
Operating Deflection	**0.36 inch**
Remarks	40 durometer

C. Inspection Report: Upon completion of the installation and after the system is put into operation, the manufacturer's representative shall make a final inspection and submit his report to the Architects and Engineers in writing certifying the correctness of installation and compliance with approved submittal data. The Contractor shall allow for the cost of this service in his bid.

PART 2 PRODUCTS

2.1 FLEXIBLE STEEL CONDUIT

A. Flexible steel conduit shall be in accordance with Section 26 05 34 – Conduit.

2.2 FLEXIBLE CONDUIT CONNECTORS

A. Flexible conduit connectors for conduit sizes greater than 2” diameter shall be Crouse-Hinds type XD expansion/deflection coupling.

2.3 VIBRATION ISOLATION MANUFACTURERS

A. The following vibration isolation manufacturers will be approved providing mounting systems are in strict accordance with design intent as specified herein:

1. Mason Industries, Inc., Hauppauge, New York.
2. Kinetics Noise Control, Dublin, Ohio.
3. The VMC Group / Amber-Booth Company, Inc., Houston, Texas.
4. The VMC Group / Korfund Dynamics, Bloomingdale, NJ.

B. Since manufacturers’ products vary, specific models listed in this Specification may not be approved if they do not meet all requirements in this Specification. Model designations listed herein are intended only as a guide.

2.4 CORROSION RESISTANCE

A. All isolators and associated hardware shall be designed or treated for resistance to corrosion.

2.5 ELASTOMER REQUIREMENTS

A. All elastomeric (rubber, neoprene) components shall be selected for lowest durometer available, Shore A rating. Hardness shall not exceed 50 durometer, Shore A rating, unless approved by project Acoustics Consultant. Use bridge-bearing quality rubber or neoprene meeting AASHTO Highway Bridge Specifications in all elastomeric components.

2.6 TYPE B: ELASTOMER-IN-SHEAR FLOOR MOUNT ISOLATORS

A. Elastomer in shear floor mount isolators shall have steel bottom plates with bolt holes, threaded steel insert at top of the mounting, and friction surfaces both top and bottom. Select mounts for deflection as required in Table 1, within rated capacities of mounts. Elastomers shall meet the conditions of Paragraph 2.5: ELASTOMER REQUIREMENTS. Mason model ND, Kinetics model RD, Amber-Booth model RVD, Korfund model RD.

2.7 TYPE K: SWAY BRACES

A. Sway braces shall be in sets of two or more and shall consist of aircraft cable, elastomers, or elastomer and spring assemblies. Braces shall keep the equipment stable without restricting the free motion of the vibration isolators.

2.8 TYPE P: CAPTIVE ELASTOMER WALL MOUNT ISOLATORS

A. Captive elastomer wall mount isolators shall contain an elastomer captured by a metal housing to provide restraint in all directions. Elastomer shall meet the conditions of Paragraph 2.5: ELASTOMER REQUIREMENTS. Select mounts for deflection as required in Table 1, within rated capacities of mounts. Mason model BR, Kinetics model RQ, Korfund model MB.

2.9 VIBRATION ISOLATION TABLE (TABLE 1)

A. Vibration isolation for all equipment shall be provided in accordance with the following Table 1 except as otherwise noted in Part 3 of this Specification.

TABLE 1: VIBRATION ISOLATION TABLE

EQUIPMENT TAG	ISOLATOR TYPE	MIN. OPERATING DEFLECTION (IN.)
Floor-Mounted Racks Containing Transformers and/or Fans	B	0.16
Wall-Mounted Racks Containing Transformers and/or Fans	P	0.05

PART 3 EXECUTION

3.1 INSTALLATION

A. Mount all equipment racks containing fans and/or transformers (amplifiers, datacom, etc.) on vibration isolators per Table 1. Install equipment to avoid rigid connection between isolated equipment and structure. Use elastomeric grommets or snubbers to prevent rigid metal-to-metal contact between anchor bolts and isolated equipment.

3.2 FLEXIBLE CONDUIT

A. Use flexible conduit for all connections to equipment that requires vibration isolation per the Contract Documents. Flexible conduit shall be a minimum length of 12” with 25% greater length than the separation between the isolated equipment and the termination of rigid conduit. Install the flexible conduit to be slack and not to exceed the manufacturer's minimum recommended bending radius. For conduit sizes greater than 2” diameter, use pre-manufactured flexible conduit connectors instead of flexible conduit.

END OF SECTION

TELEPHONE BACKBONE CABLING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install all labor and materials required for the installation of a voice backbone cabling distribution system. This system is intended to provide for distribution of traditional analog and digital dial tone. Owner will provide all patch cords, cross connects, networking equipment, telephone and monitoring equipment. Close coordination with the owner will be required.

1.2 RELEVANT SECTIONS

A. 27 05 28 Telecommunications Pathways

B. 27 13 23 Optical Fiber Backbone Cabling

C. 27 15 13 Category 5e Horizontal Cabling

D. 27 70 80 Cable Television Cabling

1.3 QUALITY ASSURANCE

A. Do all work in accordance with the guidelines published in EIA/TIA standard 568 and 569. Where conflicts exist, the plans and specifications shall take precedence. All manufacturer installation instructions shall be followed.

B. All workers involved in the installation and termination of cable shall have at least one year of experience. No less than 33% of the workmen on the job shall have attended a vendor sponsored training program covering installation and termination of cable.

1.4 SUBMITTALS

A. Submit five sets of shop drawings and product data (or a greater number if specified in Division 1 “Submittals” Section). Submittals will be required for the following items.

1. Product data for all products being proposed.

2. Backboard layout for voice backboard in the telecommunications room/Intermediate Distribution Facility (IDF).

1.5 GUARANTEE

A. Guarantee all work against faulty and improper material and workmanship for a minimum period of 1 year from the date of final written acceptance by Owner, except where guarantee or warranties for longer terms are specified herein.

B. Upon notification of a problem, the warranty provider shall furnish within 48 hours and at no cost to the owner, such labor and materials as are needed to restore the system to proper operation.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Outdoor telephone backbone

1. Backbone cable: any 24 AWG REA PE89 or PE39 cable, pair count as specified on drawings.

2. Termination: Circa Enterprises 1880 ECA, sized to match pair count of cable, fully populated with Circa 3B1FS 5-pin protector modules.

3. Overlay: Molex 27.6E.259.B001G 25 pair rj-11 pre-terminated patch panel.

B. Indoor telephone backbone

1. Backbone cable: Any ARMM type shielded twisted pair, pair count as specified on drawings.

2. Termination: 110 blocks with legs with C5 block connectors, sized appropriately to accommodate specified pair count.

3. 110 wire management: Jumper troughs installed between each 300 pair of 110 blocks.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. The Contractor shall furnish and install all cabling in accordance with these specifications, and as indicated on the cable schedules and drawings. Manufacturer installation specifications shall take precedence if there is a conflict with this section.

B. Install each cable as an uninterrupted conductor section between the designated termination points, unless otherwise directed by the cable installation specifications. There shall be no splices or mechanical coupler installed between the cable points of origin and termination except as shown on drawings and or specifications.

C. Contractor is responsible for insuring that cable jacket is suitable for the environment in which it is placed i.e.: CM, CMR, CMP rated. Unless otherwise noted on the drawings, all cable should be assumed to be rated CMR.

D. All cable shown on drawings to be routed in conduit and cable tray system, where provided.

E. At the same time cable is pulled into a cable pathway, also install a mule tape of appropriate size to facilitate future cable pulls along those pathways.

F. Surface mounted raceway or exposed cable not specifically designated require written approval of the architect.

G. Provide fire stopping at all locations where cables penetrate fire rated surfaces. Materials and methods used shall be acceptable to the code authority having jurisdiction and shall maintain the fire integrity of the wall, floor, or ceiling.

H. Contractor shall closely coordinate and work with the owner on the construction of racking and panels and termination and routing of the cabling in the telecommunications room, overhead basket tray, and into the open relay racks.

3.2 TELEPHONE BACKBONE INSTALLATION

A. Follow manufacturer instructions when installing and terminating cable.

B. When breaking out cables with more than one 25-pair binder group, each binder group must be identified with a cable tie of appropriate color at the point of fan out.

C. Outdoor telephone backbone cable:

1. Terminate cable in lighting protection units on both ends of the cable.

2. Install shield bond connectors at each end of each cable. Bond this connector to the bonding point inside the lightning protection unit.

3. Bond the lightning protection unit to the telecommunications grounding busbar.

D. Indoor telephone backbone cable:

1. Terminate cable onto wall mounted 110 blocks. The location of this telephone backbone cabling block shall be coordinated with the work specified in the horizontal cabling section. The telephone backbone cabling block shall be placed under any 110 blocks installed as part of the work specified by the horizontal cabling specification.

2. The backbone cable terminated on 110 block will be overlaid with 25 pair cable and extended to the relay rack to terminate on a 24 port rj-11 patch panel. The overlay cable shall be a pigtail with a 50 pin Amphenol connector to mate with the patch panel. Coordinate panel location with owner.

3. Install shield bond connectors at each end of each cable. Bond this connector to the telecommunications grounding busbar.

E. Lightning protection, backbone 110 blocks, and special dial tone 110 blocks shall be organized into a logical and easy to use cross connect field, with suitable wire management for cross connects between blocks, both vertically and horizontally. The scope of this work does not include installation of the special dial tone 110 blocks, however, it does include coordination with this work to provide a logical and easy to use cross connect field complete with cable management for routing of cross connect jumpers.

3.3 IDENTIFICATION

A. Telephone Backbone Cable Identification

1. Each telephone backbone cable shall be assigned a unique identifier consisting of the following components:

a. Abbreviation for the originating telecommunications room. Typical originating telecommunications room is MDF.

b. Abbreviation for the terminating telecommunications room. Typical terminating telecommunications room will be IDF-B, IDF-C, etc.

c. Pair count.

2. The unique cable ID shall be constructed from these 3 components. For example, if you were labeling a 25 pair cable that is run from the MDF room to IDF D, your cable label would be MDF-IDF-D-25.

3. Cable shall be labeled at each telecommunication room, near the location that the cable enters the telephone punch blocks.

4. Cable shall be labeled every 50’ along the length of the cable in open trays, and on each side of all wall penetrations.

5. Cable routed in conduit systems shall be labeled at each pull point. This includes the every time cable enters or exits a conduit, j-box, or pull vault.

6. Labels shall consist of permanent typewritten label systems. Hand written labels are not acceptable.

3.4 IDF AND SERVICE ENTRANCE ROOMS

A. Construction of the backboards, overhead ladder racking, and open relay racks is specified in other sections and is not included in work specified in this section.

B. Telephone backbone cable shall be routed onto overhead ladder racking systems and around the room to the backboard location indicated for termination of telephone backbone cabling.

3.5 TERMINATION HARDWARE

A. Quantities of termination blocks, racks, splice enclosures, and patch panels, etc. shown on drawings are illustrative only and are meant to indicate the general configuration of the work. The Contractor is responsible for providing the correct quantities of termination hardware required to terminate the volume of cable described herein and shown on the drawings.

3.6 CROSS-CONNECT

A. The owner will perform all cross-connects and patching unless otherwise noted.

3.7 GROUNDING

A. This specification does not include a grounding system. Grounding is specified elsewhere. That work will install a ground busbar mounted on the backboard in the IDF.

B. A 6AWG insulated conductor shall be run from the telecommunications grounding busbar to the shield of the indoor cable or to the ground point of the outdoor lightning protection.

C. All grounding shall be in compliance with the NEC code Article 800, Article 250, well as EIA/TIA standard 607.

3.8 CABLE TESTING

A. General

1. Provide 48 hour advance notice of testing.

2. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.

3. Conduct cable testing as described below upon completion of installation. Test fully completed systems only.

4. Remove all defective cables from pathways system. Do not abandon cables in place.

5. The Engineer reserves the right to observe the conduct of any or all portions of the testing process.

6. The Engineer further reserves the right to conduct, using Contractor equipment and labor, a random re-test of up to five percent (5%) of the cable plant to confirm documented test results.

7. All test results and corrective procedures are to be documented and submitted with the as-built drawings.

B. Telephone backbone testing

1. All telephone backbone twisted pair cabling shall be tested for grounds, shorts, continuity of conductors and shields, reversals, and transpositions. The contractor shall guarantee 99% good pairs on all backbone cable with no more than one bad pair in any binder group.

3.9 ACCEPTANCE

A. Upon receipt of the Contractor's documentation of cable testing, the Engineer will review the installation and may request a test in his presence, of up to 1% of the cables/wires installed.

3.10 AS-BUILT DOCUMENTATION

A. As built documentation shall include 3 copies of the following:

1. Annotated CAD prints and disks of the electrical set of prints indicating routes of installed cables, slack loop locations, and termination points.

2. All test results both in machine readable format as well as printed neatly bound and organized. Each test shall clearly indicate cable and pair designations

END OF SECTION

OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install all labor and materials required for the installation of a Corning fiber cable system.

B. Owner will provide all patch cords, cross connects, networking equipment, telephone and monitoring equipment. Close coordination with the owner will be required.

1.2 RELEVANT SECTIONS

A. 27 05 28 Telecommunications Pathways

B. 27 13 13 Telephone Backbone Cabling

C. 27 15 13 Category 5e Horizontal Cabling

D. 27 70 80 Cable Television Cabling

1.3 QUALITY ASSURANCE

A. Do all work in accordance with the guidelines published in EIA/TIA standard 568 and 569. Where conflicts exist, the plans and specifications shall take precedence. All manufacturer installation instructions shall be followed. Where conflicts exist between manufacturer instructions and these plans and specifications, the manufacturer instructions shall take precedence.

B. The installed system shall be covered by the Corning Cable Systems Corning Extended Warranty Program.

1.4 SUBMITTALS

A. Submit five sets of shop drawings and product data (or a greater number if specified in Division 1 "Submittals" Section). Submittals will be required for the following items.

1. Evidence that installing contractor is certified by Corning

2. All product data.

3. Rack layouts, including panels and wire management for all racks and cabinets.

1.5 GUARANTEE

A. The installed optical fiber cable system shall be covered by the Corning LANscape Extended Warranty Program. This warranty must cover each product component installed as well as the total performance of the optical fiber cable system. Corning Cable Systems shall guarantee to repair or replace defective products free of charge after installation.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Fiber optic distribution units shall be sized according to total number of fiber panels or modules installed:

1. 1 to 4 panels/modules: Corning CCS-03U with integrated spice housing

2. 4 to 12 panels/modules: Corning CCH-04U

3. Above 12 panels/modules: provide as many Corning CCH-04U as are required to accommodate the panels/modules.

B. Rack Mount Fiber Optic Splice Housing shall be sized according to the number of splice trays required.

1. 1 to 2 splice trays: no dedicated splice housing required if using Corning CCS-03U

2. 1 to 12 splice trays: Corning CSH-03U

3. 12 to 22 splice trays: Corning CSH-05U

C. All fiber cables shall be of an all dielectric construction

D. Outdoor Fiber Cable Package

1. Cable must be warranted by the Corning for use in outdoor applications and listed for use in applications requiring a UL listing of CMR or OFNR.

2. Cable must utilize loose buffer tube construction with no more than 12 fibers per buffer tube.

3. Cable must be water blocked, either with construction flooded or gel free with water swellable yarns and tapes.

E. Indoor Fiber Cable Package

1. Cable must fire rated for use in the space it is installed.

2. Individual fiber subunits shall consist of 900 micron tight buffer.

F. Multi Mode Fiber

1. 62.5 micro multi mode fiber cable: Corning 62.5µm/125µm. Attenuation: 3.0 dB/km @ 850 nm; 1.5 dB/km @ 1300 nm. Minimum effective modal bandwidth: 200/500 Mhz/km.

2. Multi mode ST fiber panels: Corning CCH-CP06-15T 6-fiber ST Panels

3. Multi mode ST connectors: Corning 95-101-52-SP 62.5 micron anaerobic-cure connectors

G. Single Mode Fiber

1. Cable: Corning SMF28 single mode fiber.

2. 6-Fiber Single mode SC fiber modules pre-loaded with six factory SC/UPC pigtails: Corning CCH-CP06-3C-P03RH

3. 12-Fiber Single mode SC fiber modules pre-loaded with twelve factory SC/UPS pigtails: Corning CCH-RM12-39-P03RH.

4. Splice Trays: Corning M67-048 tray for 12 single fiber heat shrink fusion splices.

H. Racking and Cabinets:

1. All racking will be provided by work in other sections. No racking is specified in this section.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. The Contractor shall furnish and install all cabling in accordance with these specifications, and as indicated on the cable schedules and drawings. Corning installation specifications shall take precedence if there is a conflict with this section.

B. Install each cable as an uninterrupted conductor section between the designated termination points, unless otherwise directed by the cable installation specifications. There shall be no splices or mechanical coupler installed between the cable points of origin and termination except as shown on drawings and or specifications.

C. Contractor is responsible for insuring that cable jacket is suitable for the environment in which it is placed i.e.: OFNR, OFNP rated. Unless otherwise noted on the drawings, all cable should be assumed to be rated OFNR.

D. All cable shown on drawings to be routed in conduit and cable tray system.

E. At the same time cable is pulled into a cable pathway, also install a mule tape of appropriate size to facilitate future cable pulls along those pathways.

F. Surface mounted raceway or exposed cable not specifically designated require written approval of the architect.

G. Provide fire stopping at all locations where cables penetrate fire rated surfaces. Materials and methods used shall be acceptable to the code authority having jurisdiction and shall maintain the fire integrity of the wall, floor, or ceiling.

H. Contractor shall closely coordinate and work with the owner on the construction of racking and panels and termination and routing of the cabling in the telecommunications room, overhead basket tray, and into the open relay racks and cabinets.

3.2 FIBER OPTIC CABLE INSTALLATION

A. Manufacturer instructions shall be carefully followed during the installation of fiber optic cable. Particular attention should be paid to pulling tension and bend radius.

B. At least 30ft of slack cable shall be coiled neatly and mounted to the telecommunications backboards using Velcro tie wraps in at each termination point.

C. Each cable shall be individually attached to the respective fiber enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

D. Fiber optic splicing/distribution shall be placed at the top of the left-most rack or cabinet in the IDF when viewed from the front of the rack or cabinet unless otherwise noted on the drawings or in this specification.

E. Indoor Fiber Cable

1. Where routed through tray system, all indoor fiber cable shall be installed in plenum rated inner duct.

2. Inner duct is not required where cable is installed in conduit and that conduit does not contain any other than fiber optic cables. In conduits that are populated with other cabling, inner duct shall be provided and installed.

F. Outdoor Fiber Cable

1. Each intermediate vault shall have 80ft of slack cable coiled and stored neatly.

2. Fanout kits shall be installed on all buffer tubes containing multi mode fiber.

3. Fanout kits are not required for single mode fiber.

G. Multi Mode Fiber Cable

1. Multi mode fiber cable shall be terminated with ST anaerobic-cure connectors.

2. Fiber shall be hand or machine polished according to Corning instructions.

3. Terminated fiber shall be mounted in standard color code order into ST bulkhead panels mounted in the fiber optic enclosures.

H. Single Mode Fiber Cable

1. Single mode fiber cable shall be terminated by fusion splicing factory SC/UPC pigtails modules onto the backbone cabling.

2. The fiber count in the SC/UPC pigtail modules shall be matched to the fiber count in the cabling being terminated.

    a. If a cable has 6 single mode fibers, then a 6-fiber pigtail module shall be used to terminate that cable.

    b. If a cable has 12 or multiples of 12 single mode fibers, then 12-fiber pigtail modules shall be used to terminate that cable.

3. Fiber slack of buffer tubes or indoor fiber sub-units shall be neatly coiled within the fiber splice enclosure. No slack loops of buffer tubes shall be allowed in the cabinet or on the relay rack.

4. Each fiber cable shall be stripped to expose the 6 or 12-fiber sub units or buffer tubes upon entering the fiber splice enclosure and the sub units or buffer tubes routed to the splice tray.

5. A maximum of 12 strands of fiber shall be spliced in each tray and no more than one cable shall be spliced in a tray, which means that some trays will only contain 6 splices.

3.3 IDENTIFICATION

A. Fiber Optic Backbone Cable Identification

1. Each fiber optic cable shall be assigned a unique identifier consisting of the following components:

    a. Abbreviation for the originating telecommunications room. Typical originating telecommunications room is Core1 or Core 2.

    b. Abbreviation for the terminating telecommunications room. Typical terminating telecommunications room will be MDF, IDF-B, IDF-C, Warehouse IDF, etc.

    c. Fiber type: MM for multi-mode, SM for single-mode, or HY for a hybrid multi and single mode cable.

    d. Strand count. If cable is a hybrid multi and single mode cable, the multi mode strand count should be indicated first, followed by the character slash "/" followed by the single mode strand count.

2. The unique cable ID shall be constructed from these 4 components. For example, if you were labeling a hybrid 24 multi mode, 12 single mode fiber cable run from the MDF to IDF B, your cable label would be MDF-IDFB-HY-24/12.

3. Cable shall be labeled at each telecommunication room, near the location that the cable enters the fiber optic panels or splice enclosures.

4. Each splice tray shall be clearly labeled with cable ID and specific strand counts in that tray.

5. Cable shall be labeled every 50’ along the length of the cable in open trays, and on each side of all wall penetrations.

6. Cable routed in conduit systems shall be labeled at each pull point. This includes the every time cable enters or exits a conduit, j-box, or pull vault.

7. Fiber optic panels shall be labeled with the destination of the fiber cable, the fiber type, the strand number within the cable.

3.4 IDF ROOMS

A. Construction of the backboards, overhead ladder racking, open relay racks, and server cabinets is specified in other sections and is not included in work specified in this section.

B. In all IDFs, the fiber optic cable shall be routed onto overhead ladder racking systems. The installation shall be coordinated with work by others.

C. Fiber optic slack loops shall be placed in out of the way locations on the walls. Slack loops shall not be placed on the overhead ladder racking, open relay racks, or server cabinets.

D. The sections that specify the work of installing the open relay racks in IDF rooms has stipulated that space at the top of the left most rack is to be reserved for fiber optic enclosures that will be installed as work specified in this section. Close coordination with the contractor installing the open relay racks is required.

3.5 TERMINATION HARDWARE

A. Quantities of termination blocks, racks, splice enclosures, and patch panels, etc. shown on drawings are illustrative only and are meant to indicate the general configuration of the work. The Contractor is responsible for providing the correct quantities of termination hardware required to terminate the volume of cable described herein and shown on the drawings.

3.6 CROSS-CONNECT

A. The owner will perform all cross-connects and patching unless otherwise noted.

3.7 CABLE TESTING

A. General

1. Provide 48 hour advance notice of testing.

2. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.

3. Conduct cable testing as described below upon completion of installation. Test fully completed systems only.

4. Remove all defective cables from pathways system. Do not abandon cables in place.

5. The Engineer reserves the right to observe the conduct of any or all portions of the testing process.

6. The Engineer further reserves the right to conduct, using Contractor equipment and labor, a random re-test of up to five percent (5%) of the cable plant to confirm documented test results.

7. All test results and corrective procedures are to be documented and submitted with the as-built drawings.

B. Fiber Optic Cable Testing

1. After all terminations have been completed, tests will be conducted using an OTDR prior to loss testing. Contractor will OTDR all fibers in both directions. OTDR testing will verify proper installation of the cable, splices, and connectors and will establish the length of the cable to be used during acceptance.

2. After OTDR testing on a span is complete, contractor shall then perform loss testing at two wavelengths specified below. Loss tests shall be recorded for each fiber for each wavelength. These values shall be used to perform acceptance calculations described below.

   a. Multi Mode fiber wavelength testing shall be at 850nm and 1310nm.

   b. Single Mode fiber wavelength testing shall be at 1310nm and 1550nm.

3. Contractor shall perform span loss calculations to compute the maximum allowed loss for each span at each wavelength. These span loss calculations shall be compared to measured performance. Span loss shall be calculated based on manufacturer guaranteed performance at the measured wavelength adjusted by the length of the cable. To that figure, span loss shall add .5dB for each mated connector and .25dB for each fusion splice. This figure is the maximum loss at that wavelength that is allowed for the cable span.

4. A fiber cable is accepted when the measured loss in all fiber strands in the cable less than the calculated span loss.

5. Cables that are not accepted will be removed and replaced at the contractor’s expense.

3.8 ACCEPTANCE

A. Upon receipt of the Contractor's documentation of cable testing, the Engineer will review the installation and may request a test in his presence, of up to 1% of the cables/wires installed.

3.9 AS-BUILT DOCUMENTATION

A. As built documentation shall include 3 copies of the following:

1. Annotated CAD prints and disks of the electrical set of prints indicating routes of installed cables, slack loop locations, and termination points.

2. All test results both in machine readable format as well as printed neatly bound and organized. Each test shall clearly indicate cable and fiber strand designations.

END OF SECTION

CATEGORY 6A BACKBONE CABLING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install all labor and materials required for the installation of PANDUIT® Augmented Category 6 cabling shown on the drawings. This backbone cabling system will provide connectivity from the MDF to individual IDFs.

B. Unless otherwise noted, owner will provide all patch cords, cross connects, networking equipment, telephone and monitoring equipment. Close coordination with the owner will be required.

C. The scope of this work includes coordination with the division 28 access control and CCTV security contractors who may need to place UTP cable and patch panels in open relay racks in the IDF.

1.2 RELEVANT SECTIONS

A. 27 05 28 Telecommunications Pathways

B. 27 13 13 Telephone Backbone Cabling

C. 27 13 23 Optical Fiber Backbone Cabling

1.3 QUALITY ASSURANCE

A. Do all work in accordance with the guidelines published in EIA/TIA standard 568 and 569. Where conflicts exist, the plans and specifications shall take precedence. All manufacturer installation instructions shall be followed.

B. Horizontal cabling system shall be provided with a one year system warranty to guarantee end-to-end high performance cabling systems that meet application requirements. The guarantee shall include cable and connectivity components and have one point of contact for all cabling system issues. The system shall be warranted for a period of at least 1 year and will include all labor and materials to correct any defect during the warranty period.

C. The contractor shall have completed Panduit product and installation training.

1.4 SUBMITTALS

A. Submit five sets of shop drawings and product data (or a greater number if specified in Division 1 “Submittals” Section). Submittals will be required for the following items.

1. All product data.

2. Backboard layout for voice/data backboard in the telecommunications room/Intermediate Distribution Facility (IDF).

3. Rack layouts, including panels and wire management for all racks.

1.5 GUARANTEE

A. The Category 6A Backbone Cabling system shall be provided with a one year system warranty to guarantee end-to-end high performance cabling systems that meet application requirements. The guarantee shall include cable and connectivity components and have one point of contact for all cabling system issues. The system shall be warranted for a period of at least 1 year and will include all labor and materials to correct any defect during the warranty period.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Category 6A unshielded twisted pair cable: any cable warranted by Panduit to support 10 Gigabit applications.

B. Category 6A patch panels: Panduit CPPL24WBLY mini-com 24 port patch panels loaded with mini-com TX6A 10Gig jacks, black in color.

C. Relay rack horizontal wire management: Panduit WMPF2E 2 position wire management panel.

PART 3 - EXECUTION

3.1 GENERAL CABLE INSTALLATION

A. The Contractor shall furnish and install all cabling in accordance with these specifications, and as indicated on the cable schedules and drawings.

B. Install each cable as an uninterrupted conductor section between the designated termination points, unless otherwise directed by the cable installation specifications. There shall be no splices or mechanical coupler installed between the cable points of origin and termination except as shown on drawings and or specifications.

C. Contractor is responsible for insuring that cable jacket is suitable for the environment in which it is placed i.e.: CM, CMR, CMP rated.

D. All cable shown on drawings to be routed in conduit and cable tray system, where provided.

E. At the same time cable is pulled into a cable pathway, also install a pull string of appropriate size to facilitate future cable pulls along those pathways.

F. Surface mounted raceway or exposed cable not specifically designated require written approval of the architect.

G. Provide fire stopping at all locations where cables penetrate fire rated surfaces. Materials and methods used shall be acceptable to the code authority having jurisdiction and shall maintain the fire integrity of the wall, floor, or ceiling.

H. Contractor shall closely coordinate and work with the owner on the construction of racking and panels and termination and routing of the cabling in the telecommunications room, overhead basket tray, and into the open relay racks.

CATEGORY 6A BACKBONE CABLING

I. Unless otherwise specified in the drawings, each IDF shall be served by 12 category 6A cables from the MDF.

J. No installed category 6A cable shall exceed 90 meters in length.

K. The contractor will be responsible for the installation of all "J-hooks" for horizontal cable support. Coordinate location of support hardware to avoid conflicts with other trades. All support hardware shall be category 5e compliant, which means that D-rings and bridle rings are not allowed.

L. Cabling shall be secured to the “J-hooks” and cable basket tray using Velcro wraps. The Velcro wraps will be cinched snug enough around the cable bundle to keep them uniform and routed neatly through the hooks or basket tray, but not so tight as to damage the cables themselves.

M. Where conduit is not provided, cable shall be bundled neatly and attached securely to building structure at intervals not to exceed 5 feet. Cable shall not be attached to conduit, ducting, or piping. It shall not be allowed to drape over building elements.

N. The category 6A cabling in the racks shall be installed with sufficient and appropriate rear mounting clips, brackets, and rear cable management to provide a secure and maintainable system.

O. Unless otherwise noted below, the category 6A cabling shall be terminated in category 5e jacks that are mounted into category 6A patch panels.

P. Horizontal front facing wire management panels are to be two position finger duct. A single wire management panel must be installed facing the front of the racks at the top position in the rack and under each patch panel. Thus, there is to be one more wire management panel than patch panel.

Q. In each IDF, space at the top of the left most rack shall be reserved for a fiber optic enclosure that will be installed under work specified in other sections.

R. The category 6A backbone cable shall be installed into patch panels that are installed under the fiber optic enclosure referenced in the above item.

S. Only category 6A backbone cabling shall be installed in the category 6A backbone patch panels. These panels shall be dedicated to backbone cabling use and not used for category 5e horizontal cabling.

T. Unless specifically directed by the owner, relay racks shall be filled from top to bottom, left to right. No IDF relay rack shall be filled with more than 22 RU of patch panels and wire management. The bottom 20RU of each IDF rack is reserved for use by the owner.

3.2 IDENTIFICATION

A. Category 6A backbone cable identification:

1. Each category 6A backbone cable shall be assigned a unique cable ID that is constructed out of the following components:

a. The IDF identification that the cable terminates in (IDF-B, IDF-C, etc.).

b. A 3-digit cable number. Each category 6A cable pulled to an IDF shall be number sequentially starting at 001 and increasing for each cable pulled to that IDF.

2. For example, the label for the 12th cable run to from the MDF to IDF B shall have cable ID IDF-B-012.

B. Patch Panel Identification

1. Above each set of jacks shall be a label indicating where the cabling runs to. If the cabling is run from the MDF to IDF-B, then the patch panel in the MDF shall be labeled "To IDF-B" and in IDF-B, the panel shall be labeled "To MDF"

2. Below each jack in every patch panel, the 3-digit cable number representing that jack. All cable numbers in all patch panels must be sequential.

3. Label shall be typewritten label tape, 3/8 inch wide with industrial strength adhesive.

3.3 TERMINATION HARDWARE

A. Quantities of termination blocks, racks, splice enclosures, and patch panels, etc. shown on drawings are illustrative only and are meant to indicate the general configuration of the work. The Contractor is responsible for providing the correct quantities of termination hardware required to terminate the volume of cable described herein and shown on the drawings.

3.4 CROSS-CONNECT

A. The owner will perform all cross-connects and patching unless otherwise noted.

3.5 CABLE TESTING

A. General

1. Provide 48 hour advance notice of testing.

2. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.

3. Conduct cable testing as described below upon completion of installation. Test fully completed systems only.

4. Remove all defective cables from pathways system. Do not abandon cables in place.

5. The Engineer reserves the right to observe the conduct of any or all portions of the testing process.

6. The Engineer further reserves the right to conduct, using Contractor equipment and labor, a random re-test of up to five percent (5%) of the cable plant to confirm documented test results.

7. All test results and corrective procedures are to be documented and submitted with the as-built drawings.

B. Category 6A cable:

1. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.

2. All category 6A cables shall be tested and certified to support 10GbaseT Gigabit Ethernet.

3.6 ACCEPTANCE

A. Upon receipt of the Contractor's documentation of cable testing, the Engineer will review the installation and may request a test in his presence, of up to 1% of the cables installed.

3.7 AS-BUILT DOCUMENTATION

A. The contractor shall provide CAD prints and disks of the electrical set of prints indicating final faceplate location, faceplate designations, rack designations, as well as major conduit, cable tray, and installed cable routes.

B. The contractor shall include machine readable results of all test results neatly bound and organized. Each test shall clearly indicate jack and/or cable designations.

END OF SECTION

CATEGORY 5E HORIZONTAL CABLING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install all labor and materials required for the installation of a PANDUIT® category 5e cabling system. This horizontal cabling system will provide connectivity from each IDF to indicated station outlets, and provide and install all open relay racks and overhead ladder racking in the IDFs.

B. Work described in this section includes all open relay racks in all IDF rooms, all overhead ladder racking for cable routing and support inside all IDF rooms.

C. Unless otherwise noted, owner will provide all patch cords, cross connects, networking equipment, telephone and monitoring equipment. Close coordination with the owner will be required.

D. The scope of this work includes coordination with the division 28 access control and CCTV security contractors who may need to place UTP cable and patch panels in open relay racks in the IDF.

1.2 RELEVANT SECTIONS

A. 27 05 28 Telecommunications Pathways

B. 27 13 13 Telephone Backbone Cabling

C. 27 13 23 Optical Fiber Backbone Cabling

D. 27 13 33 Category 6A Backbone Cabling

E. 27 70 80 Cable Television Cabling

1.3 QUALITY ASSURANCE

A. Do all work in accordance with the guidelines published in EIA/TIA standard 568 and 569. Where conflicts exist, the plans and specifications shall take precedence. All manufacturer installation instructions shall be followed.

B. Horizontal cabling system shall be provided with a one year system warranty to guarantee end-to-end high performance cabling systems that meet application requirements. The guarantee shall include cable and connectivity components and have one point of contact for all cabling system issues. The system shall be warranted for a period of at least 1 year and will include all labor and materials to correct any defect during the warranty period.

C. The contractor shall have completed Panduit product and installation training.

1.4 SUBMITTALS

A. Submit five sets of shop drawings and product data (or a greater number if specified in Division 1 "Submittals" Section). Submittals will be required for the following items.

1. All product data.

2. Backboard layout for voice/data backboard in the telecommunications room/Intermediate Distribution Facility (IDF).

3. Rack layouts, including panels and wire management for all racks.

1.5 GUARANTEE

A. Horizontal cabling system shall be provided with a one year system warranty to guarantee end-to-end high performance cabling systems that meet application requirements. The guarantee shall include cable and connectivity components and have one point of contact for all cabling system issues. The system shall be warranted for a period of at least 1 year and will include all labor and materials to correct any defect during the warranty period.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Horizontal Cabling:

1. Category 5e unshielded twisted pair cable: any manufacturer extra headroom (300+ Mhz) category 5e cable.

2. Category 5e Station Jacks: Panduit mini-com TX5e jacks CJ5E88TGXX, color to match electrical outlet color.

3. Single gang device plates: Panduit mini-com CFPnXX classic series device plates or CFPnSY for stainless steel device plates, number of jack positions as required. Match color and style of electrical trim.

4. Modular Furniture device plates: Panduit mini-com appropriate for modular furniture yet to be selected. This is a coordination issue. Bid shall include modular furniture device plates.

5. Category 5e patch panels: Panduit CPPL48WBLY mini-com 48 port patch panels loaded with mini-com TX5e jacks, black in color.

6. Special alarm and emergency dial tone IDF termination hardware: 110 blocks with legs, terminations with C4 block connectors

B. Wireless Access Point Horizontal Cabling:

1. See 2.01 A. and B. for materials with the following exception:

a. Station termination: Panduit 2-port surface mount housing for above ceiling applications and 2-port single gang device plate for terminations in finished walls.

b. Category 5e Station Jacks: Panduit mini-com TX5e jacks.

C. Security Panels, Building Automation and Power Meter Horizontal Cabling:

1. See 2.01 A. and B. for materials with the following exception:

a. All cables shall be terminated within the enclosure that serves each BAS or metering data connection.

b. Station Termination: Utilize Panduit CBXJ2EI-A surface mount box.

D. Security Cameras:

1. See 2.01 A. and B. for materials.

2. For grid ceiling mount cameras: Utilize Panduit CBXJ2EI-A surface mount box attached to closest building structure.

3. For wall mount cameras: Utilize appropriate deep electrical box for camera type.

E. IDF Racks and Ladder Rack:

1. Relay Racks: Chatsworth/CPI 55053-503 7ft relay racks

2. Vertical Wire Management Panels: Chatsworth/CPI 40093-703 MCS-EFX Vertical Wire Management.

3. Relay rack horizontal wire management: Panduit WMPF2E 2 position wire management panel.

4. Overhead ladder racking: Chatsworth/CPI 10250-118 18” wide rack, and Chatsworth/CPI 10250-124 24” wide rack.

5. Cable Runway Radius Drop: Chatsworth/CPI 12100-7XX cross member runway radius drop and Chatsworth/CPI 12101-101 string runway radius drop.

6. Cable Retaining Post: Chatsworth/CPI 10596-106 6” retaining post and 10596-108 8” retaining Post

7. Mounting hardware, splices, grounding kits, and support brackets: Chatsworth/CPI

PART 3 - EXECUTION

3.1 GENERAL CABLE INSTALLATION

A. The Contractor shall furnish and install all cabling in accordance with these specifications, and as indicated on the cable schedules and drawings.

B. Install each cable as an uninterrupted conductor section between the designated termination points, unless otherwise directed by the cable installation specifications. There shall be no splices or mechanical coupler installed between the cable points of origin and termination except as shown on drawings and or specifications.

C. Contractor is responsible for insuring that cable jacket is suitable for the environment in which it is placed i.e.: CM, CMR, CMP rated.

D. All cable shown on drawings to be routed in conduit and cable tray system, where provided.

E. At the same time cable is pulled into a cable pathway, also install a pull string of appropriate size to facilitate future cable pulls along those pathways.

F. Surface mounted raceway or exposed cable not specifically designated require written approval of the architect.

G. Provide fire stopping at all locations where cables penetrate fire rated surfaces. Materials and methods used shall be acceptable to the code authority having jurisdiction and shall maintain the fire integrity of the wall, floor, or ceiling.

H. Contractor shall closely coordinate and work with the owner on the construction of racking and panels and termination and routing of the cabling in the telecommunications room, overhead basket tray, and into the open relay racks.

3.2 HORIZONTAL CATEGORY 5E CABLE INSTALLATION

A. Unless otherwise specified, each station outlet shall consist of four (4) category 5e cables. Four port device plates shall be loaded with four jacks.

B. No installed category 5e cable shall exceed 90 meters in length.

C. All cables shall be terminated in station jacks, no direct RJ-45 or RJ-11 connections are allowed.

D. The contractor will be responsible for the installation of all "J-hooks" for horizontal cable support. Coordinate location of support hardware to avoid conflicts with other trades. All support hardware shall be category 5e compliant, which means that D-rings and bridle rings are not allowed.

E. Cabling shall be secured to the “J-hooks” and cable basket tray using Velcro wraps. The Velcro wraps will be cinched snug enough around the cable bundle to keep them uniform and routed neatly through the hooks or basket tray, but not so tight as to damage the cables themselves.

F. Where conduit is not provided, cable shall be bundled neatly and attached securely to building structure at intervals not to exceed 5 feet. Cable shall not be attached to conduit, ducting, or piping. It shall not be allowed to drape over building elements.

G. Cabling shall be installed with a 15ft slack loop placed as near to the station outlet as possible. Often this slack loop will be in the cable tray or above a drop ceiling where conduit is stubbed from the outlet box.

H. The scope of this work includes Installation of workstation cables into modular furniture systems. These systems have not yet been specified, so bid should be based on quantities of jacks shown on drawings. The actual installation shall be coordinated with the modular furniture system contractor. This includes assisting in planning cable routes into the furniture systems, selecting appropriate device plates for the furniture system, selecting appropriate outlet locations, and installing the cabling into the furniture systems at the appropriate time during the furniture system installation. Prior to the furniture system installation, the workstation cables will be pulled near the entrances to the furniture systems. The cabling shall be pulled with sufficient slack to reach the outlet location. This slack left coiled in a location where it will not be susceptible to damage. After the modular furniture systems are installed, the contractor will pull cable to the outlet locations and complete the cable installation. As of the date of the bid set of construction drawings, the modular furniture plan is not complete. Drawings are representative only and should be used to bid quantities of cabling and outlets. The drawings do not reflect actual outlet locations.

I. Installation of communications cabling into floor boxes shall be coordinated with the electrical sub contractor. Provide and install appropriate device plates for mounting the jacks in the electrical contractor installed floor boxes.

J. Installation and termination of communications cabling will require coordination with the cable television cabling work specified in 27 70 80. Coordinate cable pulls and communications device plates with this work.

K. The category 5e cabling in the racks shall be installed with sufficient and appropriate rear mounting clips, brackets, and rear cable management to provide a secure and maintainable system.

L. Unless otherwise noted below, the category 5e cabling shall be terminated in category 5e jacks that are mounted into category 5e patch panels. All cables run to a single station device plate shall be terminated on sequential jacks in the patch panels.

M. Horizontal front facing wire management panels are to be two position finger duct. A single wire management panel must be installed facing the front of the racks at the top position in the rack and under each patch panel. Thus, there is to be one more wire management panel than patch panel.

N. In each IDF, space at the top of the left most rack shall be reserved for a fiber optic enclosure that will be installed under work specified in other sections. Rack layout shall be coordinated with this work.

O. Unless specifically directed by the owner, relay racks shall be filled from top to bottom, left to right. No IDF relay rack shall be filled with more than 22 RU of patch panels and wire management. The bottom 20RU of each IDF rack is reserved for use by the owner.

P. Wall phone wiring: All outlets for wall phones are to meet ADA height and location requirements for handicapped access. For specifically identified wall phone locations, a single voice outlet shall be installed to provide voice-only communication. Two category 5e cables shall be pulled to each location. At the station end, one cable shall be tagged and coiled for future use and the other cable shall be terminated in a single category 5e jack and the jack mounted into a stainless steel wall phone plate. Both of the category 5e cables pulled to a wall phone location shall be terminated on the IDF end in the category 5e patch panel system.

Q. Pay Phone wiring: All outlets for pay phones are to meet "American Disabilities Act" (ADA) height and location requirements for handicapped access. A single voice outlet shall be installed to provide voice-only communication. Two category 5e cables shall be pulled to each location. All pay phone cabling shall be terminated at the station end in a duplex device plate with jacks blue and gray in and in the IDF end on wall-mount 110-style punch blocks.

R. Elevator wiring: For each elevator location, a duplex outlet shall be installed to provide voice-only communication. Two category 5e cables shall be pulled to each location. All elevator cabling shall be terminated in the IDF on wall-mount 110-style punch blocks. Installation of elevator system jacks shall be coordinated with the elevator installer. Provide cross connects to extend elevator dial tone from the telephone service entrance blocks to telephone backbone cabling, and then onto to this cabling.

S. Fire and Security Alarm wiring: For each alarm location, a duplex outlet shall be installed to provide communication. Two category 5e cables shall be pulled to each location. All fire and security voice cabling shall be terminated in the IDF on wall-mount 110-style punch blocks. Installation of alarm system jacks shall be coordinated with the alarm installer. Provide cross connects to extend dial tone from the telephone service entrance blocks to telephone backbone cabling, and then onto to this cabling. Network cabling shall be terminated as described in Section 3.02 T., coordinate with owner and alarm contractor for specific cable count.

T. Building Automation and Power metering wiring: For each location a duplex outlet shall be installed. They shall be in the enclosure housing the BAS and metering applications.

U. Security Camera wiring: For each camera a duplex outlet shall be installed and terminated as specified in 2.01 A. 2. For cameras mounted to ceiling grid a surface mount box shall be utilized and affixed to the nearest stable location. For wall mount cameras terminate the cables in the box utilized as the camera mount, see 3.04 B. 4. for identification.

V. The scope of this work includes coordination with the contractor installing the cable TV system. This coordination requires coordination of cable pulls and device plates where TV outlets share conduit and/or device plates with cable TV.

3.3 WIRELESS ACCESS POINT CATEGORY 5E CABLE INSTALLATION

A. Please refer to specifications outlined in the above Horizontal category 5e cable installation section.

B. Unless otherwise specified, each wireless access station outlet shall consist of two (2) category 5e cables.

C. Where the wireless access point station termination point is above the drop ceiling, the station outlet shall be terminated in a two port surface housing that is attached to the building structure or basket tray.

D. Where the wireless access point station termination is on a wall, it shall be mounted in a standard two port single gang device plate.

E. The wireless access point category 5e cabling shall be terminated on the category 5e patch panel system.

3.4 IDENTIFICATION

A. Horizontal cable identification:

1. Each category 5e cable shall be assigned a unique cable ID that is constructed out of the following components:

a. The three digit building number.

b. The IDF identification that the cable terminates in.

c. A 4-digit cable number. Each cable pulled to an IDF shall be number sequentially starting at 001 and increasing for each cable pulled to that IDF.

2. For example, the label for the 92nd cable run to IDF B in building 16 shall have cable ID 016B0092.

B. Device Plate identification

1. Each device plate shall be labeled as follows:

a. At the top of the device plate, the building number and IDF letter (for example, every device plate with conductors run to IDF B in building 16 shall have 016B at the top of the device plate).

b. Under each individual jack, the 4-digit cable number.

2. All jacks in a single device plate much have sequential cable numbers.

3. Device plate labeling shall be typewritten label tape with industrial strength adhesive.

4. For cables that not terminated in device plate or surface mount box, identify with a label equivalent to horizontal cable identification.

C. Patch Panel Identification

1. Each group of four sequential jacks representing a typical device plate in the category 5e panels must be labeled with the room number of that the device plate resides in. This room number must be the permanent room numbers assigned by the owner, not the construction room numbers. The room designation shall be placed above the jacks in the panel.

2. Below each jack in every patch panel, the 4-digit cable number representing that jack. All cable numbers in all patch panels must be sequential.

3. Label shall be typewritten label tape, 3/8 inch wide with industrial strength adhesive.

D. Security Camera Identification

1. Each security camera shall have a unique identifier label (ie: Camera1, Camera 2, etc) that is visible from the outside. See above section A for cable identification.

E. 110-Block Identification

1. Each 4-pair position on the special horizontal cable 110 blocks shall be labeled with the cable ID and the function (elevator, fire alarm, etc) on the 110 designation strip.

3.5 IDF AND SERVICE ENTRANCE ROOMS

A. Backboards are specified in other sections and will be provided and installed by others.

B. Drawings indicate number of racks to install in each IDF and provide a diagrammatic view of the overhead ladder racking. The drawings are diagrammatic only and are not necessarily indicative of the amount of overhead ladder racking that will be required to support the cabling from where it enters the room and is routed to the open relay racks. The scope of this work includes installing any and all overhead ladder racking to support all voice/data cabling that is routed inside of each IDF.

C. Contractor is responsible for providing earthquake bracing and support for all racks installed in telecommunications rooms.

D. Each relay rack must have front facing vertical wire management chases installed on each side of the rack.

E. Racks shall be firmly fastened to the floor and have overhead ladder rack run from the top of the each rack to the wall at the rear of the rack.

F. Each IDF shall have space reserved in the top left most rack for fiber optic enclosures that are specified in other sections.

G. Relay racks shall be filled from top to bottom, left to right. No IDF relay rack shall be filled with more than 22 RU of patch panels and wire management. The bottom 20RU of each IDF rack is reserved for use by the owner.

H. Contractor shall install overhead ladder racking to provide bracing as well as pathway to support and route all cabling to racks in low voltage and telecommunication rooms. The overhead ladder racking shown on drawings is illustrative only and is meant to indicate the general configuration of the work. The Contractor is responsible for providing the correct quantities of ladder racking hardware required to support the cabling described herein and shown on the drawings.

I. Overhead ladder racking must be installed to provide sufficient pathways to route limited energy cabling in the IDF rooms. Drawings are schematic design only and do not necessarily indicate the size, routing, or amount of ladder racking required to support all installed cabling. Size as needed; minimum size 18 inches. Category 5e bend radius shall be maintained by avoiding sharp corners where tray joins together at right angles as well as routing cable properly out of the tray and onto the relay racks using radius runway drops. Cable retaining posts shall be installed where needed to dress cable to the overhead ladder racking. When used, posts shall be installed with spacing no greater than 18".

3.6 TERMINATION HARDWARE

A. Quantities of termination blocks, racks, splice enclosures, and patch panels, etc. shown on drawings are illustrative only and are meant to indicate the general configuration of the work. The Contractor is responsible for providing the correct quantities of termination hardware required to terminate the volume of cable described herein and shown on the drawings.

3.7 CROSS-CONNECT

A. The owner will perform all cross-connects and patching unless otherwise noted.

3.8 GROUNDING

A. Furnish and install a telecommunications grounding system. This grounding system shall consist of a main ground busbar in the service entrance location and a ground busbar installed in each of the telecommunications rooms in the project.

B. The ground busbar shall be mounted on the IDF backboard.

C. A 2AWG insulated conductor shall be run from the main grounding busbar to each of the ground busbars in each telecommunications room. Conductor insulation shall be green in color.

D. All metallic cable tray, ladder rack, raceways, cable sheath/armor, enclosures, and equipment racks and other conductive surfaces shall be properly bonded with 5eWG insulated conductors to the grounding system. All paint and other coatings shall be removed at all contact surfaces to ensure proper ground.

E. All grounding shall be in compliance with the NEC code Article 800, Article 250, well as EIA/TIA standard 607.

3.9 CABLE TESTING

A. General

1. Provide 48 hour advance notice of testing.

2. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.

3. Conduct cable testing as described below upon completion of installation. Test fully completed systems only.

4. Remove all defective cables from pathways system. Do not abandon cables in place.

5. The Engineer reserves the right to observe the conduct of any or all portions of the testing process.

6. The Engineer further reserves the right to conduct, using Contractor equipment and labor, a random re-test of up to five percent (5%) of the cable plant to confirm documented test results.

7. All test results and corrective procedures are to be documented and submitted with the as-built drawings.

B. Category 5e cable:

1. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.

2. All category 5e cables shall be tested and certified to support 1000baseT Gigabit Ethernet.

3.10 ACCEPTANCE

A. Upon receipt of the Contractor's documentation of cable testing, the Engineer will review the installation and may request a test in his presence, of up to 1% of the cables installed.

3.11 AS-BUILT DOCUMENTATION

A. The contractor shall provide CAD prints and disks of the electrical set of prints indicating final faceplate location, faceplate designations, rack designations, as well as major conduit, cable tray, and installed cable routes.

B. The contractor shall provide 3 copies of all test results neatly bound and organized. Each test shall clearly indicate jack and/or cable designations.

END OF SECTION

ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install all labor and materials required for the installation of a complete system

1.2 RELEVANT SECTIONS

A. See also Section 08 30 00 – Specialty Doors & Frames.

B. See also Section 09 50 00 – Ceilings.

C. See also Division 14 for Elevator requirements.

D. See also Division 23 for Instrumentation & Control for HVAC (DDC) and VFD for HVAC Standards.

E. See also Division 26 for Electrical.

F. See also Division 27 for Communications.

G. See also Laboratory Appendix for environmental controls, alarming, notification, signage, etc.

H. See also appendices for various space type requirements.

I. NEC and IEEE working clearance required and to be maintained.

J. NEC and IEEE definitions will apply to all standards that follow.

PART 2 - PRODUCTS

A. None list in this section

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. UO goals of sustainability, life-cycle costs, maintainability, serviceability, high performance, quality equipment, and efficient campus inventory must be maintained. First costs may be impacted slightly as a result, but a better product will follow.

B. Access control, CCTV, and intrusion systems information shall be considered sensitive information. As such, the release of detailed information about the systems and how such systems are monitored shall be limited to those with a ‘need to know’.

C. Exterior placement of any and all equipment requires CPRE and FS approval to ensure compliance with the UO Campus Plan. If approved, all University policies shall be followed.

D. Building system zoning requires FS and Utilities & Energy Management PM review and approval.

E. NO demolition of one item shall occur in order to repair and/or replace another item.

F. ALL deleted items must be removed and not just abandoned. All abandoned or deleted conductors shall be physically removed. Conduits, pull boxes and outlet boxes small remain.

G. Systems and system components in new construction, remodels, and retrofits are to be compatible with existing systems and system components to the extent possible.

H. System Installation Requirements:

1. Systems shall be fully commissioned prior to acceptance.

2. Installer shall have a minimum of 5 years of full time experience in the installation and maintenance of systems with factory training and certification; documentation required.

3. Boxes, panels, equipment gutters, etc. are to be cleaned inside and out upon completion and prior to acceptance of work

4. Warranty repair response time: 4 hours maximum

I. Training provided MUST be to a maintenance/technician level for ALL systems. Trainings shall be conducted only by factory certified, factory trained personnel who can demonstrate a minimum of 2 years of experience in the installation and operation of the access control system installed.

J. ALL/ANY item that requires special tools and/or test equipment must be brought to the attention of the pertinent FS personnel prior to specification and/or installation.

K. Accessibility of Equipment:

1. Refer to and abide by all OSHA requirements, as appropriate.

2. Per the ‘Design Review Requirements’ at the beginning of this document, a drawing layer of ‘Maintenance Access’ is to be incorporated into ALL drawings and system designs. This layer MUST be maintained through all phases of design and construction.

3. Equipment above ceilings shall be located within corridors or above doorways.

4. Design and installation of all equipment shall be accessible for operation, maintenance, repair, and replacement as required by NEC and OSHA General Requirements. - 1910.303.

5. Thorough coordination of ceiling access(s) with electrical equipment above.

6. In mechanical and electrical rooms any components requiring routine service/maintenance must be installed / mounted below 7ft in height. Prior to installation of any component above 7ft requires onsite review and explanation with FS Maintenance and/or FS Electrical Supervisor.

7. Inaccessible Equipment:

   a. If after meetings, reviews, comments, etc., there are documented and/or discussed changes not incorporated into the construction documents and installed equipment is not accessible for operation and maintenance, equipment shall be removed and reinstalled at no additional cost to the UO or the project. Discussions of payment will occur with the design team.

   b. 'Accessible' is defined as being capable of being reached without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and ductwork. Access must not exceed 14ft in height, a typical ladder working height.

3.2 IDENTIFICATION:

1. See also Division 26 for electrical identification requirements.

2. During finish construction, labeling is to be reviewed and approved by the PM, EH&S (Fire Alarm systems), and FS Lock & Door Shop (ACS, Surveillance, and Intrusion systems).

3. All conductors (copper and fiber) shall be individually labeled within cabinets and at both ends of conductor.

3.3 RACEWAY & BOXES CONDUIT:

1. As-built one-line drawing(s) is required for all buried, encased, concealed wiring and conduit.

2. PM, EH&S (Fire Alarm systems), and FS Lock & Door Shop (ACS, Surveillance, and Intrusion systems) are to walkthrough the project to view pathways prior to encasement or enclosure.

3. Fire Alarm and monitoring, and data/telecom wiring can share the same cable trays or conduit with N&TS and EH&S approval, and with proper and complete coordination.

END OF SECTION

ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The ACS system installed under this scope of work shall provide controlled access to building interior and real-time monitoring of doors at multiple locations simultaneously.

B. The ACS system shall be controlled by FS Lock & Door Shop existing computer system. ACS system hardware installed under this scope must be compatible with current version and allows future upgrades.

C. The ACS building controllers shall be LAN addressable and shall be connected to FS Lock & Door Shop provided Ethernet receptacles.

D. At reader doors where power assist devices are located, the ACS system shall shunt the exterior power assist operator button while door is locked so that it may only be used with valid card presentation to protect power assist drive assembly.

E. The ACS system shall control primary access points to be determined with each project and requires FS Lock & Door Shop review and approval.

F. All doors controlled by ACS shall be equipped with request-to-exit (REX) devices and door contracts.

1.2 SUBMITTALS:

A. Manufacturer's specifications and technical data for all components.

B. List of programming decisions that need to be made by the FS Lock & Door Shop for proper operation of the system. Included in this list shall be all console/local passwords or access codes as well as any proposed field-assigned passwords or access codes.

C. Panel and power supply drawings layouts on backboard allocated for CCTV and ACS in telecommunications closet. Indicate desired location of 120 VAC power receptacles on this drawing for coordination.

D. One-line diagram showing all devices, controllers, and cable types between devices.

1.3 QUALITY ASSURANCE:

A. All workers involved with this installation must have completed manufacturer training and have a minimum of 2 years experience installing like equipment or have a minimum of 5 years of installation experience with specified equipment.

PART 2 - PRODUCTS:

Access Control Product:	Manufacturer:	Model:	Note(s):
Building ACS Controllers	AMAG	Multi-Node 2100 series	Required to integrate into existing campus access control system.

Access Control Product:	Manufacturer:	Model:	Note(s):
Proximity Readers	Indala	FlexPass mid-range FP3213A+ / 10022	To be 26 Bit Wiegand compliant for card only entry. Or with optional keypad entry.
ACS Rex Device	Bosch	To be approved	
ACS Door Contact	Sentrol	To be approved	
ACS Door Prop Alarm	Design Security, Inc.	To be approved	With key switch.
Electrified Locking Device	VonDuprin	6000 series; 24VDC strike plates	-
	HES	9600 series; 24VDC surface mounted rim device	-
Magnetic Door Lock Device	-	-	Allowed ONLY with prior FS Lock & Door Shop review and approval.
Wire & Cable	-	CAT 5	UL listed for use in plenum spaces. Installed per manufacturer's instructions.
Outdoor Wire & Cable	-	CAT 5	UL listed for outdoor use; wet environments; recommended for such use by manufacturer. Installed per manufacturer's instructions.
Door Release Button	-	-	Momentary switch as approved by FS Lock & Door Shop. Located at DVR or monitor station.
Post Base for Card Reader	-	-	OFCI; Division 08

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all equipment and cabling in a manner consistent with manufacturer recommendations and instructions.

B. Install all devices and components shown on drawings required for proper operation of the system.

C. Mount devices level and in a uniform fashion.

D. Install FS Lock & Door Shop furnished post bases for card readers in coordination with concrete pours.

E. Also coordinate installation and pours with required power.

F. Contractor shall furnish and install all cabling associated with the operation of both CCTV and ACS system.

G. Contractor shall not pull any ACS cables in conduits containing or intended to contain voice and data wiring.

3.2 EQUIPMENT & SYSTEMS:

A. Coordinate with FS Lock & Door Shop setup of Ethernet network and IP address assignment; setup programming for ACS building controllers; reader definitions; door alarm points.

B. When the installation of all system components and cabling is complete, initial testing shall consist of local walk-through, and working demonstration of all features.

C. All passwords or access codes for the system shall remain at factory default unless the factory default poses a security risk, in which case all passwords shall be communicated in writing and give written FS

D. Lock & Door Shop approval of such change. Any costs associated with password recovery shall be borne by the Contractor.

E. The Owner shall be provided with a minimum of 2hrs training of the installed system after all startup and testing procedures have been completed and as-built documentation delivered.

1. Minimum hours of required training may increase based upon the system size and complexity.

2. Training will include both an overview for building occupants and an in-depth session for FS maintenance to a service level.

F. Prior to FS Lock & Door Shop final acceptance of the system all zones must be tested in the presence of designated representative(s) from FS Lock & Door Shop.

3.3 CLOSEOUT, WARRANTY, AND SUPPORT:

A. With as-builts, record drawings, O&M manuals, etc. deliverables a complete list is required of all system devices, power packs, etc. noting their installed locations.

B. Guarantee all work against faulty and improper material and workmanship for a minimum of 1 year from the date of final written acceptance by FS Lock & Door Shop, except where guarantee or warranties for longer terms are clearly requested and specified.

C. During the entire warranty period the Contractor must provide all related software upgrades to the installed system(s).

D. Upon notification of a problem, the warranty provider shall furnish within 48 hours at no cost to the Owner such labor and materials as are needed to restore the system to proper operation.

E. During the entire warranty period the Contractor must guarantee a 4 hour response time for problem resolution.

F. Prior to the end of the warranty period, with FS Lock & Door Shop present, the Contractor is to conduct a 1 year inspection repairing any item(s) at Contractor’s cost and provide a report of system equipment and system operational functions.

END OF SECTION

ELECTRONIC SURVEILLANCE

PART 1 - GENERAL

1.1 SURVEILLANCE AND INTRUSION SYSTEMS

A. All labor, equipment, materials, documentation and services necessary for a complete and operational Closed Circuit TV (CCTV) monitoring system. Work will include the installation of wiring, cabling, cameras, power supplies, digital video controllers, flat panel displays, and other components necessary to provide a fully operational CCTV monitoring.

B. Installed system shall be a turnkey package including design review, construction supervision, coordination, and commissioning services.

C. OFOI and/or OFCI hardware will be determined by each project with the FS Lock & Door Shop.

D. The system wiring, equipment, and installation shall comply with all listed requirements as well as any and all applicable national, state and local codes and standards.

E. System Description:

1. The CCTV monitoring system installed shall provide for real-time monitoring of multiple cameras at multiple viewing locations simultaneously, as well as, recording for later review of video.

2. The CCTV system shall be equipped with a video recorder (DVR or NVR where applicable NVR equipment is specified) that shall have the following characteristics:

a. Equipped with a 16 port PoE (Power over Ethernet) switch or 16 camera ports.

b. Equipped to serve remote display of live and recorded video over client LAN. Client software shall be provided with DVR / NVR.

c. Record at a minimum of 12 frames per second with DVR system and 5-7 frames per second with NVR system for each camera location simultaneously.

d. Feature that it records only when motion is detected. Motion is defined to be changes in pixels on a camera allowing the user to specify the percent pixel change that defines motion.

e. DVR / NVR shall be a 16 camera unit with 500 GB storage capacity.

f. Stored video shall be retrievable from the DVR / NVR indexed by time and have fast-forward and rewind functions.

g. DVR shall be equipped with a keyboard, mouse, and 17” color LCD display.

h. DVR / NVR shall allow live monitoring and continuous recording while viewing stored video.

3. Cameras shall:

   a. Be 1/3 inch color cameras having minimum of 480 TV lines of resolution. IP cameras capable of low-light recording (IR if needed) and high resolution (720 lines of resolution or greater). All camera models must be approved by FS Lock & Door Shop.

   b. Have vari-focal lenses and auto-iris to allow for field-of-view optimization and ability to automatically adjust to changing lighting conditions. Lenses shall be those recommended by camera manufacturer.

   c. Be powered over limited energy conductors from a central power supply mounted in the communications closets of Point of Entry.

   d. Mini-dome cameras are to be used at elevator cab ceilings. Elevator Subcontractor will install coax cable in elevator traveling cable. CCTV Contractor shall run cable from elevator machine rooms to DVR / NVR and monitor. Coordinate camera installation in elevators with elevator installer.

   e. Inventory of cameras may include: areas with cash handling equipment; bike storage; primary

   f. Entries; stairwells; etc. Camera inventory and locations will be determined by each project and require FS Lock & Door Shop review and approval.

4. The CCTV system shall be equipped with FS Lock & Door Shop specified number of cameras.

5. Surveillance Products: The appropriate product models are to be approved by designated FS Lock & Door Shop during project design and specification.

PART 2 - PRODUCTS

Surveillance Product:	**Manufacturer:**	**Model:**	**Note(s):**
Network Video Recorder	AMAG stand alone NVR or DELL server		Where applicable NVR system and equipment are requested and specified.
IP Cameras	AXIS or approved		IP cameras must be compatible with AMAG NVR Solutions system.
Cameras	ALL	ALL	At least 720 lines of TV resolution during normal lighting conditions. Low-light cameras may switch to black & white in low lux conditions. See also, previous system description within this section.
Camera Power Supply	Altronix		16 fused output and 24 VAC. Or approved equal.

Camera Mounts & Adapters	-		ALL cameras to include necessary mounts and adapters recommended by manufacturer for the application.
Camera Cable	-		Cat5e or Siamese type depending on installation.
Security/Burglar Alarm	Radionics, Bosch, or Detection System Control Units	-	Programmable by Bosch RPS software, version 3.7 or later.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Quality Assurance: All workers involved with this installation must have completed manufacturer training and have a minimum of 2 years experience installing like equipment or have a minimum of 5 years of installation experience with specified equipment.

B. Install all equipment and cabling in a manner consistent with manufacturer recommendations and instructions.

C. Install all devices and components shown on drawings required for proper operation of the system.

D. Mount devices level and in a uniform fashion.

E. Camera power supplies are to mount in the Point of Entry rooms.

F. Wiring to cameras shall be CAT 5e twisted pair and shall include any necessary components to transmit video and power across CAT 5e cabling.

G. Contractor shall furnish and install all cabling associated with the operation of CCTV system.

H. Contractor shall **not** pull any CCTV cables in conduits containing or intended to contain voice and data wiring.

3.2 SURVEILLANCE AND INTRUSION SYSTEMS AND EQUIPMENT

A. Coordinate with FS Lock & Door Shop setup of Ethernet network and IP address assignment; camera setup to ensure proper focus and view to satisfaction.

B. When the installation of all system components and cabling is complete, initial testing shall consist of local walk-through, and working demonstration of all features.

C. All passwords or access codes for the system shall remain at factory default unless the factory default poses a security risk, in which case all passwords shall be communicated in writing and give written FS

D. Lock & Door Shop approval of such change. Any costs associated with password recovery shall be borne by the Contractor.

E. The Owner shall be provided with a minimum of 2hrs training of the installed system after all startup and testing procedures have been completed and as-built documentation delivered.

1. Minimum hours of required training may increase based upon the system size and complexity.

2. Training will include both an overview for building occupants and an in-depth session for Facilities maintenance to a service level.

F. Prior to FS Lock & Door Shop final acceptance of the system all zones must be tested in the presence of designated representative(s) from the FS Lock & Door Shop.

3.3 SURVEILLANCE AND INTRUSION SYSTEMS CLOSEOUT, WARRANTY, AND SUPPORT

A. With as-builts, record drawings, O&M manuals, etc. deliverables a complete list is required of all system devices, power packs, etc. noting their installed locations.

B. Guarantee all work against faulty and improper material and workmanship for a minimum of 1 year from the date of final written acceptance by FS Lock & Door Shop, except where guarantee or warranties for longer terms are clearly requested and specified.

C. During the entire warranty period the Contractor must provide all related software upgrades to the installed system(s).

D. Upon notification of a problem, the warranty provider shall furnish within 48 hours at no cost to the Owner such labor and materials as are needed to restore the system to proper operation.

E. During the entire warranty period the Contractor must guarantee a 4 hour response time for problem resolution.

F. Prior to the end of the warranty period, with FS Lock & Door Shop present, the Contractor is to conduct a 1 year inspection and provide a report of system equipment and system operational functions.

END OF SECTION

DIGITAL, ADDRESSABLE FIRE ALARM 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 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Magnetic door holders.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.

2. Include voltage drop calculations for notification appliance circuits.

3. Include battery-size calculations.

4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.

2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.

b. NICET-certified fire-alarm technician, Level III minimum.

c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.

2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.

3. Record copy of site-specific software.

4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

a. Frequency of testing of installed components.

b. Frequency of inspection of installed components.

c. Requirements and recommendations related to results of maintenance.

d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.

6. Abbreviated operating instructions for mounting at fire-alarm control unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On magnetic media or compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

1.9 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. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.

2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.

3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.

4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.

5. Keys and Tools: One extra set for access to locked and tamperproofed components.

6. Audible and Visual Notification Appliances: One of each type installed.

7. Fuses: Two of each type installed in the system.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. 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.

E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.11 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of fire-alarm service.

2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

1.12 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide Notifier, a Honeywell company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Heat detectors.

2. Smoke detectors.

3. Duct smoke detectors.

4. Verified automatic alarm operation of smoke detectors.

5. Automatic sprinkler system water flow.

6. Heat detectors in elevator shaft and pit.

7. Fire-extinguishing system operation.

8. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
8. Activate stairwell and elevator-shaft pressurization systems.
9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
10. Recall elevators to primary or alternate recall floors.
11. Activate emergency lighting control.
12. Activate emergency shutoffs for gas and fuel supplies.
13. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.

6. Break in standby battery circuitry.

7. Failure of battery charging.

8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.

2. Detectors shall be four-wire type.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.

b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).

c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

   a. Primary status.

   b. Device type.

   c. Present average value.

   d. Present sensitivity selected.

   e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

   a. Primary status.

   b. Device type.

   c. Present average value.

   d. Present sensitivity selected.

   e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

   a. Primary status.

   b. Device type.

   c. Present average value.

   d. Present sensitivity selected.

   e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.

4. Each sensor shall have multiple levels of detection sensitivity.

5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

E. Single-Station Duct Smoke Detectors:

1. Comply with UL 268A; operating at 120-V ac.

2. Sensor: LED or infrared light source with matching silicon-cell receiver.

a. Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) when tested according to UL 268A.

3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.

a. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.

4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.4 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.5 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.

B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

F. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.

3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.

4. Flashing shall be in a temporal pattern, synchronized with other units.

5. Strobe Leads: Factory connected to screw terminals.

6. Mounting Faceplate: Factory finished, white.

2.6 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.

2. Wall-Mounted Units: Flush mounted unless otherwise indicated.

3. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.7 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.8 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.

2. Connect new equipment to existing monitoring equipment at the supervising station.

3. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

D. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.

2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.

3. Smooth ceiling spacing shall not exceed 30 feet (9 m).

4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.

5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.

6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

F. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

G. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

H. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

M. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.

2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.

3. Smoke dampers in air ducts of designated air-conditioning duct systems.

4. Alarm-initiating connection to elevator recall system and components.

5. Alarm-initiating connection to activate emergency lighting control.

6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

7. Supervisory connections at valve supervisory switches.

8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

9. Supervisory connections at elevator shunt trip breaker.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.

b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test audible appliances for the private operating mode according to manufacturer's written instructions.

5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION

SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clearing and protection of vegetation.

B. Protection of existing track and built elements.

1.2 PROTECTION

A. Protect existing built elements during construction. Leave in as good condition as found.

B. Protect track with geotextile fabric, plywood, and steel plates as required to prevent damage. Do not park, operate equipment, or store material or equipment on unprotected track surface.

C. Maintain benchmarks, monuments, and other reference points. If disturbed or destroyed replace as directed.

D. Contact utility locate service prior to Work. Contractor is responsible for public and private locates. Protect active utilities and maintain in continuous operation during site preparation and construction. Repair damage to utilities at Contractor's expense.

E. Protect existing lawn, trees, and landscape areas to remain. Install fencing and signage as required to prevent damage.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 SITE CLEARING

A. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

B. Mark cut lines and notify Owner's Representative for approval prior to cutting.

3.2 EXISTING UTILITIES AND BUILT ELEMENTS

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.

3.3 VEGETATION

A. Scope: Remove trees, shrubs, brush, and stumps in areas where new improvements occur and as indicated on Drawings.

B. Notify City of Eugene Urban Forestry staff when performing and work within the Right of Way that is within the Critical Root Zone of existing trees.

C. Vegetation Removed: Do not burn, bury, landfill, or leave on site.

1. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches.

2. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.

D. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.4 DEBRIS

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.

D. Power wash and clean dirt or sediment off paving from construction activities.

END OF SECTION

EARTH MOVING

THIS SPEC SECTION IS A PLACE HOLDER FOR THE 100% DD SUBMITTAL AND WILL BE UPDATED BY CAPITAL ENGINEERING (CIVIL) FOR A SUBSEQUENT SUBMITTAL. REFER TO THE GEOTECHNICAL REPORT, REFERENCED BELOW.

PART 1 GENERAL

1.1 CONTRACT CONDITIONS

A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.2 SECTION INCLUDES

A. Excavation and fills, including compaction, of on-site private building, pavement, and landscaped areas.

1.3 RELATED SECTIONS

A. Section 31 23 33 - Trenching and Backfill

1.4 REFERENCED SPECIFICATIONS

A. ODOT Standard Specifications (latest revision).

1.5 **REFERENCED DOCUMENTS**

A. **Geotechnical Report: Geotechnical Investigation, Oregon Bach Festival Offices, University of Oregon, Eugene, Oregon; by GRI, dated March 28, 2016.**

B. **All earthwork operations shall comply with the recommendations and requirements of the Geotechnical Report.**

1.6 WORK INCLUDED BUT SPECIFIED ELSEWHERE

A. Products and construction within the City of Eugene right-of-way shall conform to the 2008 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendments.

1.7 DEFINITIONS

A. Rock: Material that cannot be removed by one-yard shovel, by backhoe with 9,500 lb. digging force, by pick and shovel, or by 200 HP Crawler fitted with normal excavating equipment. Ripper attachment as might be hooked into seam is not considered "normal" excavating equipment.

B. Unstable Soil: Soft, loose, wet, or disturbed ground that is incapable of supporting material, equipment, personnel, or structure.

C. Wet Weather Conditions: Wet Weather Conditions apply to materials placed during dry weather but which are subsequently subjected to rainfall and equipment or construction traffic. The Contractor shall be responsible for the performance of the selected type of material.

D. Large Woody Debris: Tree trunks over 8 inches in diameter and a minimum of 12 feet long (without root wads), cleaned to be free of weeds or weed seed by power washing subject to approval by Owner's Wetlands Consultant prior to installation in Wetland Mitigation Areas.

1.8 SUBMITTALS

A. Comply with Section 01 33 00, unless otherwise noted.

B. Product Data: Manufacturer's specifications and technical data including performance, construction, and manufacturing information.

1. Submit for: Subgrade geotextile.

C. Samples: Submit material sample(s) (2 quart minimum) to the Geotechnical Engineer of the following product for approval prior to delivery to site.

D. Field Quality Control: Submittals as specified in Part 3 of this section.

1. Field Tests.

2. Special Inspections for Code Compliance.

E. Closeout Requirements: Comply with Section 01 77 00.

1. Provide record documents.

1.9 QUALITY REQUIREMENTS

A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

B. Installers Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

C. Product/Material Qualifications:

1. Design Data: Compaction testing shall be in accordance with Section 01 45 00, QUALITY CONTROL.

2. Test Reports: Provide imported material gradation test reports. Provide material compaction test reports.

D. Observation and Inspection: Owner will retain a Geotechnical Engineer to monitor earthwork operations.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.

1. Protect from damage by the elements and construction procedures.

1.11 ADVANCE NOTICES

A. Notify Engineer at least 48 hours before starting work of this section.

1.12 COORDINATION

A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.1 STABILIZATION FILL

A. Imported, clean, angular quarry rock, 3-inch or 6-inch minus material, open-gradation.

2.2 CRUSHED ROCK FILL AND PAVEMENT BASE

A. Imported clean 3/4" -0 or 1-1/2" - 0 crushed rock or crushed gravel, free from foreign material and conforming to the requirements of ODOT Standard Specification (latest revision) 02630.

2.3 OPEN-GRADED CRUSHED ROCK FILL

A. Imported, clean 3/4" - 1/4" angular, crushed rock or crushed gravel, free from foreign material with no more than 2 percent passing the No. 200 sieve.

2.4 SUBGRADE STABILIZATION GEOTEXTILE

A. Subgrade woven geotextile; grab tensile strength 300 lb minimum per ASTM D4632 (latest revision) each direction; burst strength 600 psi per ASTM D3786 Mod. (OSHD TM814) (TF 25. Method 3); puncture strength 120 lb per ASTM D4833 (latest revision) or ASTM D3787 Mod. (OSHD TM 816); No. 40 sieve per ASTM D4751 (latest revision) or smaller opening; 0.05 sec water permittivity per ASTM D4491 (latest revision). Mirafi 600X or approved.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

A. Prior to starting of the work of this section verify that existing grades and field conditions agree with drawings. Notify Engineer of deviations.

B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.

C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.2 PROTECTION

A. Monuments: Carefully maintain bench marks, monuments, and other reference points. If disturbed or destroyed, replace as directed.

B. Existing Utilities: Existing utilities shall be field located. Protect active utility lines encountered. Repair or replace utility lines damaged by work of this Section.

C. Pavement Cleaning: Maintain pavements and walkways clean at all times.

D. Dust Control: Protect persons and property against damage and discomfort caused by dust; water as necessary and when directed.

E. Other Work and Adjacent Property: Protect against damage caused by work of this section.

3.3 GENERAL REQUIREMENTS

A. Contractor shall perform all excavation necessary or required for proper construction of the work and placement or installation of materials.

B. Cutting Pavements: Cut vertical, straight-line joints using power saw designed for cutting pavements.

C. Line and Grade: Excavate to lines and grades shown on the drawings or as established by the Engineer.

D. Shoring: Shore excavations when necessary to prevent caving during excavation in unstable material, or to protect adjacent structures, property, workers, and the public or as required by local, state, or federal agencies. Shoring shall be removed, as the backfilling is done, in a manner that does not damage work or permit voids in the backfill. It shall be the sole responsibility of the Contractor to see that safety requirements are met.

E. Temporary stockpiling of Excavated Materials: Excavated materials may be placed in approved areas. Do not obstruct roadways, bikeways, or pedestrian walkways. Conform to all federal, state and local codes governing the safe loading of excavated materials adjacent to excavations.

F. Excess Excavation: Where excavation, through the Contractor's error, is carried to levels lower than those shown on drawings, backfill with specified bedding material to proper levels at Contractor's expense.

G. Drainage: Except as otherwise permitted, excavation shall be done in a manner as to provide for adequate drainage. In excavation where gravity drainage is not practical, the Contractor shall provide pumps and accessories with which to remove and dispose of all water, including but not limited to, surface water from rainfall entering the excavations, as required to accomplish the work and as required by governing jurisdictions.

H. Backfilling shall not commence until after excavations have been inspected. Backfill shall be placed in such a manner as not to disturb, damage, or subject such facilities to unbalanced loads or forces. Make fills as soon as feasible after Engineer's review and acceptance.

I. If rock or unstable soil are encountered, notify Engineer. Removal of rock or unstable soil will be paid for as an addition to the contract.

3.4 GEOTEXTILE PLACEMENT

A. Acquisition and Storage: Provide complete rolls of geotextile as furnished by the manufacturer, and protect against damage and deterioration. Store all geotextile rolls in a dry place and off the ground at all times according to ASTM D4873 (latest revision). Cover all rolls and partial rolls with a dark protective covering when received. The geotextile will be rejected for use if the Engineer determines it has defects, deterioration, or has been damaged.

B. Surface Preparation: Prepare the surface receiving the geotextile to a smooth condition free of obstructions, depressions, and debris unless otherwise directed. Do not drag the geotextile on the ground or mishandle it in any way.

C. Loosely place the geotextile without wrinkles so placement of the overlying material will not tear the geotextile. Lap or sew the geotextile at the ends and sides of adjoining sheets as specified.

D. On Slopes: Place the geotextile with the machine direction oriented up-down the slope. Lap the upper sheets over the top of the lower sheets. When the geotextile is placed on a slope steeper than 6:1, securely anchor the laps to the ground surface with pins or stakes as necessary to prevent slippage and tearing of the geotextile. Start placement of fill material on the geotextile at the toe of the slope and proceed upwards.

E. Overlap: Minimum overlap shall be 24 inches.

F. If the Engineer determines the specified overlap is not sufficient, increase the overlap to provide adequate coverage or sew the geotextile together in the field. If field-sewn, the provisions of ODOT 00350.20 and 00350.41(a-3) apply.

G. Protection of Geotextile: Protect the geotextile at all times from ultraviolet (UV) rays, contamination by surface runoff, and construction activities.

H. Traffic or construction equipment will not be permitted directly on the geotextile except as authorized by the Engineer. When placed for construction, cover the geotextile with specified cover material as soon as possible.

I. Place cover material on the geotextile in a manner that the geotextile is not torn, punctured, or shifted. Use a minimum 6-inch-thick cover layer or twice the maximum aggregate size, whichever is thicker. End-dumping cover material directly on the geotextile will not be permitted.

J. Limit construction vehicles in size and weight so rutting in the initial layer above the geotextile is not more than three inches deep or one half the layer thickness, whichever is less. Turning of vehicles on the first layer will not be permitted.

K. Repair of Geotextile: Repair or replace all torn, punctured, or contaminated geotextiles during construction at no cost to the Owner. Repair by placing a patch of the specified geotextile over the affected area. Where geotextile seams are required to be sewn, repair any damaged sheet by sewing unless otherwise indicated on the plans or special provisions or as directed.

3.5 CLEARING AND GRUBBING

A. Clear and grub site in all areas to receive improvements. Clearing shall be the removal of all brush, grass, shrubs, trees, weeds, rubbish, structures, pavements, and debris flush with or slightly below original ground surface. Remove willow and blackberry, if any, to not less than 12 inches below original ground surface. Grubbing shall be the removal of all stumps and roots larger than 1-1/2 inches in diameter, rocks larger than 6 inches, and existing structures to the following levels:

1. In areas to receive landscaping: to not less than 12 inches below finished grade.

2. In areas to receive structures or pavements: to not less than 18 inches below subgrade.

B. Dispose of all cleared and grubbed materials off site.

3.6 EXCAVATION AND FILLS AT PAVEMENT AREAS

A. Excavate any additional existing material to the grades required on the drawings. Remove any additional excavated material from site.

B. Do not traffic the subgrade with construction equipment or vehicles until proof roll. Proof roll the sub-grade as directed by the Engineer and Geotechnical Engineer. Unstable material shall be overexcavated as directed by the Engineer and Geotechnical Engineer. Overexcavation will be paid for as an addition to the contract. Overexcavated material shall be removed from site. Use Crushed Rock Fill to fill the voids left after overexcavation. Place fill in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ±3 percent.

C. Place subgrade geotextile over entire subgrade.

D. Use Crushed Rock Fill to raise the grade to the bottom of the pavement section elevation. Place fill in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ±3 percent. Fill that cannot be tested shall be compacted to the approval of the Engineer and Geotechnical Engineer.

E. Place Crushed Rock Pavement Base. Place base material in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision). Place fill in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ±3 percent.

3.7 EXCAVATION AND FILLS AT BUILDING AREAS

A. Excavate any additional existing material to the grades required on the drawings. Remove any additional excavated material from site.

B. Building Slab Preparation:

1. Do not traffic the subgrade with construction equipment or vehicles until proof roll. Proof roll the sub-grade as directed by the Engineer and Geotechnical Engineer. Unstable material shall be overexcavated as directed by the Engineer and Geotechnical Engineer. Overexcavation will be paid for as an addition to the contract. Overexcavated material shall be removed from site. Use Crushed Rock Fill to fill the voids left after overexcavation. Place fill in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ±3 percent.

2. Place subgrade geotextile over entire subgrade.

3. Place a minimum depth of Crushed Rock Fill to provide a 12-inch working pad. Top of pad shall be 12 inches below finished floor elevation. Place fill in 8-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ±3 percent. It shall be the contractor's responsibility to maintain and repair the building slab base after initial testing and approval.

4. Use Crushed Rock Fill to raise the grade to the building subgrade elevation. Place fill in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ±2 percent. Fill that cannot be tested shall be compacted to the approval of the Engineer and Geotechnical Engineer.

5. Vapor Barrier Installation: Refer to structural or architectural plans.

6. Place Crushed Rock base. Place base material in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ±2 percent.

C. Foundation Preparation:

1. Building foundations shall be supported on a minimum 12 inches of Bar Run Fill or Crushed Rock Fill. The Bar Run Fill or Crushed Rock Fill shall extend horizontally on all sides of the footing a minimum distance equal to one-half the depth of the fill. Place Subgrade Geotextile in the footing locations at the direction of the Geotechnical Engineer.

2. Place fill in 8-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ±2 percent. Fill which cannot be tested shall be compacted to the approval of the Engineer and Geotechnical Engineer. It shall be the Contractor's responsibility to maintain and repair the building foundation fills after initial testing and approval.

3.8 GRADING

A. Perform all earthwork to the lines and grades shown on the drawings. Shape and finish slopes to conform to the lines, grades, and cross sections as shown or approved by the Engineer. Provide positive drainage away from buildings and sidewalks.

3.9 MAINTENANCE OF EARTHWORK

A. Contractor shall maintain all earthwork surfaces until all work has been completed and accepted. Such maintenance shall include, but not be limited to, addition of appropriate backfill material to keep backfilled surface smooth, free from ruts and potholes, and suitable for traffic flow.

3.10 DISPOSAL OF WASTE MATERIAL AND EXCESS EXCAVATION

A. Remove from site excess material that is unsuitable for backfilling or stockpiling at the Contractor's expense.

3.11 SETTLEMENT

A. Any settlement in earthwork which occurs during the warranty period and is attributable to construction procedures, such as improper removal of shoring or insufficient compaction, shall be corrected by the Contractor at his own expense. Any piping or facilities damaged by such settlement shall be restored to their original condition at the Contractor's expense.

3.12 FIELD QUALITY CONTROL

A. Refer to Section 01 45 00 for responsibilities for arranging, supervising, and payment of field quality control requirements.

B. Field Tests:

1. Subgrade compaction testing.

2. Material compaction testing.

3. Imported material gradation testing.

C. Field Inspections: Notify Engineer prior to work of this section.

D. Special Inspections for Code Compliance: Obtain building inspector approvals.

3.13 CLEANING

A. Upon completion of the work of this section promptly remove from the working area all scraps, debris, and surplus material.

3.14 PROTECTION

A. Protect all work installed under this section.

B. Replace at no additional cost to Owner, any damaged work of this Section.

END OF SECTION

TRENCHING AND BACKFILL

PART 1 GENERAL

1.1 CONTRACT CONDITIONS

A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.2 SECTION INCLUDES

A. Excavation and fills, including compaction, of on-site private storm drain, sanitary sewer and water distribution systems.

1.3 RELATED SECTIONS

A. Section 31 20 00 – Earth Moving

1.4 REFERENCED SPECIFICATIONS

A. ODOT Standard Specifications (current edition).

1.5 DEFINITIONS

A. Rock: Material that cannot be removed by one-yard shovel, by backhoe with 9,500 lb. digging force, by pick and shovel, or by 200 HP Crawler fitted with normal excavating equipment. Ripper attachment as might be hooked into seam is not considered “normal” excavating equipment.

B. Unstable Soil: Soft, loose, wet, or disturbed ground that is incapable of supporting material, equipment, personnel, or structure.

1.6 SUBMITTALS

A. Comply with Section 01 33 00, unless otherwise indicated.

B. Product Data: Manufacturer's specifications and technical data including performance, construction, and manufacturing information.

C. Field Quality Control submittals as specified in Part 3 of this Section.

1. Field Tests

2. Special Inspections for Code Compliance

1.7 QUALITY REQUIREMENTS

A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

B. Installer's Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

C. Product/Material Qualifications:

1. Design Data: Compaction testing shall be in accordance with Section 01 45 00, QUALITY CONTROL.

2. Test reports: Provide imported material gradation test reports. Provide material compaction test reports.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.

1. Protect from damage by the elements and construction procedures.

1.9 ADVANCE NOTICES

A. Notify Engineer at least 48 hours before starting work of this section.

1.10 COORDINATION

A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.1 CRUSHED ROCK

A. Imported, clean, 3/4" - 0 crushed rock or crushed gravel, free from foreign material and meeting the requirements of ODOT Standard Specifications (current edition) 02630.

B. To be used for Pipe Base Material, Pipe Zone Material, and Trench Backfill.

2.2 CONTROLLED DENSITY FILL

A. Controlled Density Fill (CDF) shall be a mixture of cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, self-consolidating, free-flowing and excavatable material which will result in a hardened, dense, non-settling fill.

B. Mix Design: Mix design shall conform to the following. The weights shown are only an estimate of the amount to be used per cubic yard of CDF. The actual amounts may vary from those shown if approved by the Engineer. The Contractor shall submit additional data to be approved by the Engineer.

Proportions per Cubic Yard

Maximum Compressive Strength	100 - 250 p.s.i.
Maximum Mixing Water	30 - 50 gals.
Cement	30 - 50 lbs.
Fly Ash	200 - 350 lbs.
Dry Aggregate	2700 - 3200 lbs.

C. CDF used to fill abandoned pipe: The Contractor shall submit certified engineering data, for the proposed mixture to be used, for the following:

1. 30 and 90 day unconfined compressive strength (C') tests as described in ASTM D4832 with the following exception: cylinders will not be capped.

2. Yield and dry unit weight additional (ASTM D6103)

3. Flowability (ASTM D6023)

4. Removability (Removability Modules RE=<1.0)

5. Mixture's components and sources (company and location). Previous test results, on the same mixtures using the same components, will satisfy this requirement.

2.3 DRAIN ROCK

A. Imported, clean, 1/2" to 1-1/2" uncrushed, nearly round aggregate free from foreign material and meeting the requirements of ODOT Standard Specifications (current edition) 01090.12.

2.4 DRAINAGE GEOTEXTILE

A. Non-woven geotextile; grab tensile strength 90 lb minimum per ASTM D4632 each direction; burst strength 185 psi minimum per ASTM D3786; puncture strength 55 lb minimum per ASTM D4833 or ASTM D3787 OSHD TM 816; No. 70 sieve or smaller opening per ASTM D4751; minimum 150 gal/min/ft^2. Amoco 4545 or approved.

2.5 IMPERMEABLE LINER

A. *Note that CAPITAL Engineering is researching additional impermeable liner options.*

B. Manufacturer:

1. Hercushield 2400 by In-Line Plastics, LC.

2. RPE 15 by Layfield.

3. Substitutions: See Section 01 60 00, PRODUCT REQUIREMENTS.

C. Material: Liner shall be UV resistant and shall have the following average properties (values from individual rolls should not vary from these values by more than +/- 10%):

Property	Test Method	Requirements
Appearance		Black or Black/Silver
Nominal Thickness		12 mils
Weight		6 oz/SY
Tensile Strength	ASTM D751 (Method A)	215 lbs. Warp 175 lbs. Weft
Tear Strength (Tongue)	ASTM D751 (Method B)	60 lbs. Warp 64 lbs. Weft

Accelerated Weathering/UV	ASTM G53-84	More than 80% strength retention after 2,000 hrs 350 psi
Mullen Burst	ASTM D751	350 psi

D. Accessories:

1. Tape: As approved by the manufacturer.

2.6 TRACER WIRE

A. Electrically conductive tracer wire, 18 - gauge, insulated copper or heavier, green in color, or other approved material. To be placed full length of trench with non - metallic pipe.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

A. Prior to starting work of this section, verify that existing grades and field conditions agree with drawings. Notify Engineer of deviations.

B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.

C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.2 PROTECTION

A. Monuments: Carefully maintain bench marks, monuments, and other reference points. If disturbed or destroyed, replace as directed.

B. Existing Utilities: Existing utilities shall be field located. Protect active utility lines encountered. Repair or replace utility lines damaged by work of this section.

C. Pavement Cleaning: Maintain pavements and walkways clean at all times.

D. Dust Control: Protect persons and property against damage and discomfort caused by dust; water as necessary and when directed.

E. Other Work and Adjacent Property: Protect against damage caused by work of this section.

3.3 GENERAL REQUIREMENTS

A. Contractor shall do all trenching and excavating necessary or required for proper construction of the work and placement or installation of materials. Tunneling or jacking shall not be used unless approved in writing by the Engineer.

B. Cutting Pavements: Cut vertical, straight - line joints using power saw designed for cutting pavements. Cut minimum one foot beyond each side of trench.

C. Obstructions: Remove all obstructions encountered within the trench area or adjacent thereto. If requested by Contractor, Engineer may make minor changes in trench alignment to avoid major obstructions, provided such alignment changes can be made without adversely affecting the intended function of the facility. Contractor shall pay any additional costs resulting from such alignment changes.

D. Trenching: Minimum trench width to be 12 inches greater than outside diameter of pipe. Maximum trench width at top of trench shall not be limited except where excess width of excavation would cause damage or create damage to adjacent structures or facilities.

E. Line and Grade: Excavate trench to lines and grades shown on the drawings or as established by the Engineer with proper allowances for pipe thickness and special bedding when required.

F. Shoring: Shore trench when necessary to prevent caving during excavation in unstable material, or to protect adjacent structures, property, workers, and the public or as required by local, state, or federal agencies. Shoring shall be removed, as the backfilling is done, in a manner that will not damage pipe or permit voids in the backfill. It shall be the sole responsibility of the Contractor to see that safety requirements are met.

G. Temporary Stockpiling of Excavated Material: Locate at least 2 feet from trench edges. Place excavated material only within approved areas. Do not obstruct roadways, bikeways, or pedestrian walkways. Conform to all federal, state and local codes governing the safe loading of excavated materials adjacent to trenches.

H. Excess Excavation: Where excavation, through Contractor's error, is carried to levels lower than those shown on drawings, backfill with specified bedding material to proper levels at Contractor's expense.

I. Drainage: At all times keep trenches dry. Provide and operate pumping equipment necessary to keep excavations free from standing water. Dispose of water in manner to prevent damage to adjacent property and as required by governing jurisdiction.

J. If rock or unstable soil are encountered, notify Engineer. Removal of rock or unstable soil will be paid for as an addition to the contract.

3.4 EXCAVATION

A. Excavate trenches to the line and grades shown on the drawings.

3.5 IMPERMEABLE LINER

A. Place at filter strips that are within 10 feet of buildings and place under stormwater detention area, as shown on drawings.

B. Acquisition and Storage: Provide complete rolls of liner as furnished by the manufacturer, and protect against damage and deterioration. Store all liner rolls in a dry place and off ground at all times according to ASTM D4873. Cover all rolls and partial rolls with a dark protective covering

when received. The liner will be rejected for use if the Architect determines it has defects, deterioration, or has been damaged.

C. Surface Preparation: Prepare the surface receiving the liner to a smooth condition free of obstructions, depressions, and debris unless otherwise directed. Do not drag the liner on the ground or mishandle it in any way.

D. Installation: The subgrade surface is to be uniform and free of rocks, depressions, voids, and irregularities that might damage liner. Install impermeable liner in accordance with liner manufacturer's written recommendations.

1. The liner should be placed in the perimeter trench first. The trench liner should be separate from the liner on the field. Overlap field and trench sections a minimum of 18 inches in the direction of water flow.

2. Overlap joints a minimum of 8 inches. All laps shall be overlapped in direction the water flows.

3. Continuously tape all joints to provide an impermeable liner.

4. Place a suitable amount of ballast on the liner to prevent movement by wind. The ballast shall be in a form that will not damage liner.

5. Direct loading on the fabric by traffic shall not be allowed. A minimum of 4 inches of material cover must be placed prior to traffic.

6. Repair punctured or torn liner by overlapping additional fabric and joining in accordance with manufacturer's recommendations.

7. The liner must completely line perimeter trench in a continuous manner.

E. Limit construction vehicles in size and weight so rutting in the initial layer above the liner is not more than 3 inches deep or one-half the layer thickness, whichever is less. Turning of vehicles on the first layer will not be permitted.

F. Repair of Liner: Repair or replace all torn, punctured, or contaminated liners during construction at no cost to the Owner. Repair by placing a patch of the specified liner over the affected area. Where liner seams are required to be sewn, repair any damaged sheet by sewing unless otherwise indicated on the plans or special provisions, or as directed.

3.6 BACKFILL

A. Backfilling shall not commence until after pipe, conduit, structures, and other equipment and appurtenances placed in trench or similar excavations have been properly constructed or installed, as applicable, and inspected. Backfill shall be placed in such a manner as not to disturb, damage, or subject such facilities to unbalanced loads or forces. Make fills as soon as feasible after Engineer's review and acceptance.

B. Pipe Base: Place required thickness of Pipe Base Material over full width of trench. Provide uniform bearing under entire length of each pipe.

C. Pipe Zone: Place required thickness of Pipe Zone Material over full width of trench.

D. Above Pipe Zone: Backfill full width of trench to paving subgrade elevation or to within depth of loam in landscaped areas with Trench Backfill.

E. Compaction: Trench backfill shall be compacted in maximum 24 inch lifts to:

1. 95 percent compaction under pavement areas per ASTM D698 at an optimum moisture content of ±3 percent.

2. 90 percent compaction elsewhere per ASTM D698 at an optimum moisture content of ±3 percent.

3. Water settling of trench backfill will not be considered an acceptable compaction procedure.

3.7 MAINTENANCE OF TRENCH BACKFILL

A. Contractor shall maintain all backfilled trench surfaces until all work has been completed and accepted. Such maintenance shall include, but not be limited to, addition of appropriate backfill material above the pipe zone to keep backfilled trench surface smooth, free from ruts and potholes, and suitable for traffic flow.

3.8 ABANDONING PIPE IN PLACE (FOR UNDER AND WITHIN 2 FEET OF BUILDING)

A. When required, all abandoned pipes shall be plugged at each end and filled with a controlled density fill (CDF). The CDF shall be pumped into each pipe segment from the downstream end. The material's flow characteristics will be such to allow free flow and total fill to pipe crown. If the pipe contains water, the CDF may be used to displace water.

B. The CDF material shall be protected from freezing. Filling of each pipe segment shall be as continuous as possible.

C. Field testing for flowability (ASTM D6023) each batch of CDF for a uniform 8 inch diameter spread or as approved by Engineer to achieve total pipe fill.

D. Contractor shall monitor CDF filling to assure pipes are filled to the crown. Verification of total pipe fill to be submitted to Engineer. Verification procedure to be approved by Engineer prior to start of filling process.

3.9 DISPOSAL OF WASTE MATERIAL AND EXCESS EXCAVATION

A. Remove from site excess material and that unsuitable for backfilling.

3.10 SETTLEMENT

A. Any settlement in trench backfill which occurs during the warranty period and is attributable to construction procedures, such as improper removal of shoring or insufficient compaction, shall be corrected by the contractor at his own expense. Any piping or facilities damaged by such settlement shall be restored to their original condition at the Contractor's expense.

3.11 FIELD QUALITY CONTROL

A. Refer to Section 01 45 00 for responsibilities for arranging, supervising, and payment of field quality control requirements.

B. Field Tests:

1. Material compaction testing:

a. Trench Compaction: A minimum of one field density test shall be conducted on compacted material for every 100 linear feet, or fraction thereof, of trench and for every 3 feet, or fraction thereof, of fill placed.

2. Imported material gradation testing.

C. Field Inspections: Notify Engineer prior to work of this section.

D. Special Inspections for Code Compliance: Obtain building inspector approvals.

3.12 CLEANING

A. Upon completion of the work of this section promptly remove from the working area all scraps, debris, and surplus material.

3.13 PROTECTION

A. Protect all work installed under this section.

B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

FLEXIBLE PAVING

PART 1 GENERAL

1.1 CONTRACT CONDITIONS

A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.2 SECTION INCLUDES

A. Asphaltic concrete pavements and crushed rock pavement base for on-site private improvements.

1.3 WORK INCLUDED BUT SPECIFIED IN OTHER SECTIONS

A. Section 31 20 00 – Earth Moving

1.4 REFERENCED SPECIFICATIONS

A. 2008 Oregon Standard Specifications for Construction, HMAC Pavement Reference, Section 00744.

1.5 SUBMITTALS

A. Comply with Section 01 33 00, unless otherwise indicated.

B. Product Data: Manufacturer's specifications and technical data including performance, construction, and fabrication information.

1. Submit for job mix formulas (JMF).

C. Field Quality Control submittals as specified in Part 3 of this Section:

1. Field Tests.

D. Closeout Requirements: Comply with Section 01 77 00.

1. Special warranties

2. Provide record documents.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

B. Installer's Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

C. Pre-installation Conference: Contractor, installer, Engineer, and representatives of other affected trades shall meet at site to review paving operations, acceptance of substrata surfaces, and coordination with other trades.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.

1. Protect materials and maintain product temperature during delivery.

1.8 SPECIAL WARRANTIES

A. Contractor shall warrant installed pavement for a period of 2 years from date of Substantial Completion. When notified in writing from Owner, they shall promptly and without inconvenience and cost to Owner correct said deficiencies to comply with requirements.

1.9 COORDINATION

A. Coordinate with other trades affecting or affected by work of this section.

1.10 ADVANCE NOTICES

A. Notify Engineer at least 48 hours before starting work of this section at each site.

PART 2 PRODUCTS

2.1 CRUSHED ROCK PAVEMENT BASE

A. Under Dense Graded HMAC Mixture: Imported Clean 3/4"-0 or 1-1/2"-0 dense graded crushed rock or crushed gravel, free of foreign material and meeting the requirements of ODOT Standard Specifications (current edition) 02630, Base Aggregate.

2.2 HOT MIXED ASPHALT CONCRETE (HMAC)

A. Asphalt Mixture: The asphalt concrete mixture shall be a well-graded, uniform coated, durable mix of the mix type(s) as shown on the plans or approved by the Engineer.

BROADBAND LIMITS

DENSE GRADED MIXTURE

Sieve Size Passing	Percentage of Total Aggregate (by weight) 1/2" Dense	Percentage of Total Aggregate (by weight) 3/4" Dense
1"	--	99-100
3/4"	99-100	92-100
1/2"	90-100	75-91
1/4"	52-80	50-70
No. 10	21-46	21-41
No. 40	8-25	6-24
No. 200	3-8	2-7
Asphalt Cement	4-8	4-8

B. Asphalt Cement (Binder): Per Oregon Standard Specifications for Construction, (current edition). Use PG (Performance Grade) 64-22 for base and wearing courses.

C. Aggregate for Base Course Mix: Per Oregon Standard Specifications for Construction (current edition).

D. Aggregate for Wearing Course (Top Lift of HMAC) Mix: Per Oregon Standard Specifications for Construction (current edition).

E. Fine Aggregate: Per Oregon Standard Specifications for Construction (current edition).

F. Mineral Filler: Finely ground particles of limestone, hydrated lime, or other mineral dust, free of foreign matter.

G. Asphalt Tack Coat: Type CSS-1, CSS-1h, CMS-2, CMS-2S, CMS-2h, CRS-2, HFRS-2 or HFMS-2 emulsified asphalt (EA) conforming to Standard Specifications for Highway Construction (current edition).

H. Reclaimed Asphalt Pavement (RAP) Material: Shall not exceed 30% in the new pavement. Rap material not permitted in open graded or Level 4 HMAC pavement, in accordance with Standard Specifications for Highway Construction (current edition). Asphalt mixtures including RAP to meet all normal specification and Oregon Standard Specifications for Construction (current edition) requirements.

2.3 JOB MIX FORMULA (JMF)

A. Mix Formula: The Contractor shall submit a JMF for each mixture to be used on the project and meeting the Level 2 criteria of Oregon Standard Specifications for Construction, Current Edition.

B. The Contractor shall supply the job mix design to the Engineer ten (10) work days prior to production. The job mix formula shall be no more than five (5) years old.

C. Approval: No paving shall occur until the Contractor receives written approval of the Contractor's job mix formula.

2.4 HMAC ACCEPTANCE

A. The mixture will be accepted by visual inspection of the Engineer. If the mixture is considered suspect, the Contractor shall obtain samples under the observation of the Engineer and tested as per Oregon Standard Specifications for Construction, Current Edition (section 00744.16). Testing shall be performed by an independent testing agency paid for by the Contractor. Contractor to be reimbursed by Owner if testing shows HMAC is within the specified limits and tolerances.

2.5 HMAC PRODUCTION QUALITY CONTROL/ASSURANCE

A. As specified for Level 2 HMAC in the Oregon Standard Specifications for Construction, Current Edition. Submit the appropriate documentation/reports to Engineer for review.

2.6 MODIFICATION OF MIXES

A. Modification: The Engineer reserves the right to modify specified mixes for use under various traffic conditions on various segments of the work and for feathering, spot patching, and other special purposes. The Contractor shall provide mixes proportioned as directed by the Engineer for such purposes.

2.7 WHEEL STOPS

A. Shall be precast wheel stops, 72 inch length, with 1 inch hole for rebar attachment.

2.8 PAVEMENT MARKINGS

A. Traffic paint shall be white traffic marking paint, unless otherwise noted on drawings, two (2) coats, 18.0 mil minimum dry film thickness, Sherwin Williams, Benjamin Moor, Rodda, or approved.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

A. Prior to starting of the work of the section verify that existing grades and field conditions agree with drawings. Notify Engineer of deviations.

B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.

C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.2 WEATHER LIMITATIONS

A. Surface Temperature: Asphalt concrete shall be placed on a dry prepared surface when the surface temperature is not less than specified below.

Nominal Specified Compacted Thickness of Individual Courses	
2" to 2-1/2"	50°F
2-1/2" and over	40°F

B. Weather: Asphalt concrete shall not be placed during rain or other adverse weather conditions. However, if approved by the Engineer, the mix in transit at the time the adverse conditions occur may be laid if the mix has been covered during transit and is at the specified temperature, if the foundation is free from pools or flow of water, and if all other requirements of these specifications are met. Asphalt concrete mixtures shall not be placed when the foundation is frozen or when, in the opinion of the Engineer, existing or expected weather conditions will prevent the

proper handling, finishing, or compaction of the mixtures. *Dense graded mixes shall only be placed from 3/15 – 9/30*.

C. Ambient Temperature Caution: The Contractor is cautioned that placing asphalt concrete on cool days when the temperature is less than 60°F may require an adjustment in Contractor's normal placing and compaction procedures so that specified minimum compaction requirements will be met. The temperatures shown in the table in this section are not recommended temperatures for paving, but paving may be allowed at these temperatures on the condition that specified pavement compaction is achieved.

3.3 ASPHALT CONCRETE PAVING MACHINE

A. Pavers: Pavers shall be self-contained, power-propelled units with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing layers of asphalt concrete material to the widths thicknesses, lines, grades, and cross sections required.

3.4 COMPACTORS

A. Rollers: Rollers shall be steel wheel, pneumatic tire, vibratory or a combination of these types. They shall be in good condition and capable of reversing without backlash.

3.5 PREPARATION OF FOUNDATION

A. Bases: All bases and foundations on which the pavement is to be constructed shall meet the applicable specifications and be approved prior to the start of paving. Existing bases and foundations shall be reconditioned as specified or directed.

B. Edges: Broken or ragged edges of existing paved surfaces underlying or abutting the new pavement shall be trimmed back to firm material. Surfaces against which asphalt concrete is to be placed shall be treated with an asphalt tack coat.

C. Tack Coat: Prior to placing each lift of asphalt concrete, tack coat asphalt shall be applied to completely cover all cold longitudinal joint and all prepared existing asphalt and Portland cement concrete surfaces. Immediately before applying the tack coat, the surface to be tacked shall be clean and dry. The application rate shall be between 0.05 and 0.20 gallons per square yard of surface area to achieve uniform, thorough coverage and as approved by the Engineer. Emulsified asphalt temperature to be between 140 and 185°F and application to be in accordance with manufacturer's recommendations.

3.6 CRUSHED ROCK PAVEMENT BASE PLACEMENT

A. Placement and compaction shall conform to the requirements of Section 31 20 00, Earth Moving.

3.7 PLACING ASPHALT PAVEMENT - SINGLE COURSE

A. Place asphalt within 24 hours of applying tack coat. Do not place HMAC pavement on the tack coat until the asphalt separates from the water (breaks), but before it loses its tackiness.

B. Place up to 3 inch compacted thickness in one lift.

C. Install drainage covers and frames in correct position and elevation.

D. Compact pavement by rolling. Do not displace or extrude pavement from position. Use hand-operated compacting equipment in areas inaccessible to rolling equipment.

E. Develop rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.8 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

A. Place asphalt within 24 hours of applying tack coat. Do not place HMAC pavement on the tack coat until the asphalt separates from the water (breaks), but before it loses its tackiness.

B. Place wearing course over base course in two compacted lifts for pavement thicknesses over 3 inches.

C. Place wearing course over base course as soon as possible.

D. Compact pavement by rolling. Do not displace or extrude pavement from position. Use hand-operated compacting equipment in areas inaccessible to rolling equipment.

E. Develop rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.9 CONTROL OF LINE AND GRADE

A. Line and Grade: The Contractor shall furnish, place, and maintain supports, wires, devices, and materials as necessary to provide continuous line and grade reference control to the automatic paver control system on either or both sides of the paving machine.

3.10 HAULING, DEPOSITING AND PLACING

A. Hauling: Cover HMAC if rain or cold air temperatures are encountered any time between loading and placement. Engineer may reject material compromised (below specified temperature, slumping or separating, solidifying or crusting). Rejected loads will be disposed of off-site at the Contractor’s expense.

B. Depositing: Material shall be deposited from vehicles to prevent segregation.

C. Placing: Do not place material during rain or other adverse weather conditions, unless allowed by Engineer. Material placed in adverse conditions is to meet all normal contract specification requirements. Material in transit at the time adverse conditions occur may be placed if it has been covered during transport, it is placed in areas free of standing or flowing water, temperature and all other requirements are met.

3.11 TEMPERATURE CONTROL

A. Temperature of Mixture:

1. The temperature of the mixture at the time it is placed in final position shall be within 10 degrees of 280°F. The Engineer may adjust the lay-down temperature in 10-degree

increments to attain maximum workability and compaction. In no case shall the lay-down temperature of mixture be less than 240°F.

3.12 COMPACTION

A. Rolling: Immediately after the asphalt concrete mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and uniformly rolled until the mixture is compacted. Complete breakdown and intermediate compaction before the mix temperature drops below 180°F.

B. General:

1. The type, number, and weight of rollers shall be sufficient to compact the mixture while it is still within the specified temperature range. Rollers shall not be operated in vibratory mode when the temperature of the mixture has dropped below 180 degrees.

2. Steel roller wheels shall be moistened with water or other approved material to the least extent necessary to prevent pickup of mixture and not cause spotting or defacement of the surface of the mixture.

3. Rollers shall be operated at speeds recommended by the roller manufacturer and slow enough to avoid displacement of the mixture. The maximum speeds shall be 3 miles per hour for steel-wheeled rollers and pneumatic-tired rollers, unless faster speeds are approved.

4. Care shall be exercised not to displace the line and grade of edges. Displacement of any course occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of approved rakes and addition of fresh mixture when required.

5. Any mixture that becomes loose and broken, contaminated, segregated, or is in any way defective, shall be removed and replaced with new mixture at no expense to the Owner.

6. Finish rolling shall continue until all roller marks are eliminated.

7. Along curbs and walls, on walks, irregular areas, and other areas not practicably accessible to specified rollers, the mixture shall be compacted with approved self-propelled rollers, mechanical tampers, hot hand tampers, or heavy hand rollers. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.

C. Density Requirements:

1. The Contractor is responsible for process control and shall conduct sampling, testing, measurement and inspection. The contractor shall provide daily nuclear density testing (ODOT Test Method 310C-87) to develop rolling patterns necessary to achieve the minimum compaction requirement of 91 percent as determined by Rice Density Test AASHTO T 209 as modified by ODOT TM 306. This is in addition to Owner's testing as necessary to ensure the finished pavement meets specifications. A copy of all

compaction test reports shall be provided to the Engineer. Contractor to immediately take corrective measures when it is determined that specified compaction density is not achieved. If specified compaction density cannot be achieved the Contractor shall remove and replace the defective asphalt areas at the Contractor's expense. The Owner has the option of accepting these areas with a reduced payment to the Contractor.

2. Asphalt compaction below 88 percent as determined by Rice Density Test AASHTO T 209 as modified by ODOT TM 306 is not acceptable.

3. The Architect will determine the suitability of the final product through final acceptance testing. Results of these tests will be used to determine payment deductions, if any to be assessed against the Contract. The final density of each paving project location will be determined by averaging the results of a minimum of five (5) density tests taken with a nuclear gauge (ODOT TM 310C-87) at randomly selected locations within each paving project.

4. Paving in areas 6 feet wide or less and irregular areas not accessible by large rollers are not subject to the minimum compaction per (2) above.

5. The Owner shall take acceptance tests to verify that the work meets specifications.

3.13 PAVEMENT SMOOTHNESS

A. Utility Structures: The joint between the pavement and the top surface of utility structures, such as manhole covers and valve boxes located in the traveled way, shall meet the pavement surface tolerances.

B. Tolerance: The surface of the finished pavement shall be within 0.02 foot of the specified line, grade, and cross section.

C. Texture: The completed surface of all courses of the mixture shall closely parallel that specified for the top surface of the finished pavement and shall be smooth, uniform on texture and conform to the specified crown and grade.

D. Job control testing shall be performed with a 10 foot straightedge furnished and operated by the Contractor. The Engineer may observe this testing, or the Engineer may require additional testing to be performed under the Engineer's supervision. Operations to eliminate the unacceptable pavement shall be corrected by the Contractor using a method or methods listed below and approved by the Engineer.

E. Roughness: When tests show the pavement is not within the above tolerances, the Contractor shall take immediate action to correct equipment or procedures in the paving operations to eliminate the unacceptable pavement roughness.

F. Method of Correction: Any surface irregularities exceeding the above tolerances shall be corrected by the Contractor using a method or methods listed below and approved by the Engineer.

3.14 FIELD QUALITY CONTROL

A. Refer to Section 01 45 00 for responsibilities for arranging, supervising, and payment of field quality control requirements.

B. Field Tests:

1. Base rock compaction testing.

2. Asphaltic concrete pavement compaction testing.

3. Asphaltic concrete pavement gradation testing.

C. Field Inspections: Notify Engineer prior to paving operations.

3.15 CORRECTIVE ACTION

A. Corrective Measures: The Engineer shall require one or more of the following corrective measure be performed on the deficient areas:

1. Remove and replace the surface course.

2. Place an overlay of a thickness approved by the Engineer.

3. Grind the pavement surface utilizing diamond blades up to a maximum depth of 0.3 inch and apply an emulsion fog coat as directed by the Engineer.

B. Additional Corrective Work: After completion of the corrective work, if the Engineer finds it is still not satisfactory, the Contractor shall perform additional corrective work on areas still not meeting the above tolerances.

C. Expense: All corrective work, including furnishing of materials, shall be performed at the Contractor's expense and no adjustment in contract time will be made for corrective action work.

D. Localized Surface Irregularities: Where surface irregularities are localized or where the Engineer determines corrective work would not be in the Owner's best interests, the Engineer may deduct from payment due the Contractor amounts equivalent to the Engineer's estimate of work costs had the corrective work been done.

3.16 STRUCTURE ADJUSTMENT

A. Prior to placement of wearing course, locate and adjust to finished pavement grade all catch basins and other structures and appurtenances within the pavement area.

3.17 WHEEL STOPS

A. Attach to pavement with 18 inch length rebar driven through wheel stop hole into pavement. Seal holes.

3.18 PAVEMENT STRIPING

A. All areas to be marked shall be cleaned to insure proper bonding. Cleaning shall consist of flushing and sweeping plus a detergent cleaning of oil spills. Sweeping shall be completed no more than eight (8) hours prior to application of markings.

3.19 CLEANING

A. Trim and remove excess asphalt concrete accumulations from abutting structures such as curbs, manholes, catch basins, and other structure.

B. Including work of other sections, clean, repair and touch-up, or replace when directed, products which have been soiled, discolored, or damaged by work of this section. Remove excess spilled material and debris from project site upon work completion or sooner, if directed.

C. Upon completion of the work of this section promptly remove from the working area all scraps, debris, and surplus material.

3.20 PROTECTION

A. In addition to other required provisions for traffic, the following shall apply to pavement construction: No traffic or equipment shall come in contact with the compacted mixture until it has cooled and set sufficiently to prevent marking; edges shall be protected from being broken down; and edge drop-off(s) one inch or more in height shall be marked with approved reflectorized and/or flashing warning devices visible by day and night to the traveling public, and placed at spacings as specified by the Engineer.

B. Protect all work installed under this section.

C. Replace at no additional cost to Owner, any damaged work of this section.

END OF SECTION

CONCRETE CURBS, GUTTERS, WALKS AND PAVEMENTS

PART 1 GENERAL

1.1 CONTRACT CONDITIONS

A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.2 SECTION INCLUDES

A. On-site private curb, gutter, walks and pavements.

1.3 RELATED SECTIONS

A. Section 03 11 00 - Concrete Forming *(needs to be verified)*

B. Section 03 30 00 - Cast-In-Place Concrete

C. Section 31 20 00 - Earth Moving

D. Section 32 13 73 - Concrete Paving Joint Sealants *(needs to be verified)*

1.4 WORK INCLUDED BUT SPECIFIED ELSEWHERE

A. Products and construction within the City of Eugene right-of-way shall conform to the 2008 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendments.

1.5 DESIGN AND ENGINEERING

A. Formwork design and engineering, as well as construction, are the sole responsibility of the Contractor.

1.6 SUBMITTALS

A. Comply with Section 01 33 00, unless otherwise indicated.

B. Quality Control:

1. Submit joint layout drawings for Architect and Landscape Architect’s review and acceptance.

C. Field Quality Control Submittals:

1. Before starting work and in accordance with Section 01 33 00, prepare mockups for Engineer's review and acceptance of concrete walk surface texture.

a. Minimum Panels Size: 4 ft. square.

b. Re-prepare, if directed, until accepted.

c. Accepted mockup represents minimum quality standard. Work of lesser quality will be subject to rejection and replacement.

2. Accepted mockup, in like new condition, may be used in contract work.

D. Closeout Requirements: Comply with Section 01 77 00.

1. Provide record documents.

1.7 WEATHER PRECAUTIONS

A. Provide cold weather and/or hot weather protection as recommended in ACI 306 and ACI 305.

B. Unless adequate protection is provided, concrete shall not be placed during rain, sleet, or snow. Protect concrete from rain water, maintain concrete water ratio and protect concrete surface.

C. All concrete shall be adequately protected after pouring to prevent damage from freezing, by the use of suitable cover. Frozen and damaged concrete must be removed and replaced at the Contractor's expense. Do not place concrete on frozen earth.

1.8 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

B. Installers Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

C. Product/Material Qualifications:

1. Design data: Compaction testing shall be in accordance with Section 01 45 00, QUALITY CONTROL.

2. Test reports: Provide job mix test reports.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.

1. Protect from damage by the elements and construction procedures.

1.10 ADVANCE NOTICES

A. Notify Engineer at least 48 hours before intended concrete placement.

B. Place no concrete until formwork and reinforcement have been inspected.

1.11 COORDINATION

A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.1 CRUSHED ROCK PAVEMENT BASE

A. Imported, clean, 3/4"-0 Crushed Rock Pavement Base as specified in Section 31 20 00, EARTH MOVING.

2.2 CAST-IN-PLACE CONCRETE

A. Non-vehicular concrete shall be ready-mixed conforming to Section 03 30 00, CAST-IN-PLACE CONCRETE, and shall have a minimum compressive strength of 3,000 psi at 28 days.

B. Vehicular concrete shall be ready-mixed conforming to Section 03 30 00, CAST-IN-PLACE CONCRETE, and shall have a minimum compressive strength of 4,000 psi at 28 days.

2.3 FORMS

A. Conform to Section 03 11 00, CONCRETE FORMING.

2.4 CURING COMPOUND

A. Curing compound for all other concrete shall conform to AASHTO M171, White Polyethylene Film for curing concrete or AASHTO M148, Liquid Membrane-Forming Compounds for Curing Concrete.

2.5 TACTILE WARNINGS

A. On private site, shall be black truncated dome warning surface per University standards.

B. Within right-of-way, comply with City of Eugene standards.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

A. Prior to starting work of this section verify that existing grades and field conditions agree with drawings. Notify Engineer of deviations.

B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.

C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.2 EXCAVATION

A. All excavation shall be in accordance with Section 31 20 00, EARTH MOVING.

3.3 CRUSHED ROCK BASE

A. After the subgrade is compacted and at the proper grade, spread required thickness of 3/4-inch minus crushed rock. Compact by rolling or other approved method. Surface of the compacted base shall be at the proper level to receive the concrete. Manholes, catch basins, inlets, and other such structures shall be completed, adjusted, cured, and otherwise prepared, as applicable, and made clean and ready to have concrete placed in contact with them.

3.4 FORMWORK

A. Conform to the requirements of Section 03 11 00, CONCRETE FORMING. Construct forms to the shape, lines, grades, and dimensions called for on the Drawings. Stake wood or steel forms securely in place, true to line and grade. Brace forms to prevent change of shape of movement in any direction resulting from the weight of the concrete during placement.

B. Allowable Tolerances: Tops of forms shall not depart from grade line more than 1/8-inch when checked with 10-foot straightedge. Alignment of straight sections shall not vary more than 1/8-inch in 10 feet.

3.5 FINISHING

A. After the pavement has been struck off and consolidated, it shall be scraped with a straightedge equipped with a handle to permit operation from the edge of the pavement. Any excess water shall be removed from the surface of the pavement. Irregularities shall be corrected by adding or removing concrete. All disturbed places shall be again straightedged.

B. After the concrete has been given a preliminary finish, the surface of the pavement shall be checked by the contractor with a straightedge device. Each successive check with the straightedge device shall lap the previous check path by at least half the length of the straightedge. Surface deviations exceeding 0.01 foot shall be corrected. Upon completion of the surface floating, but before any required edge tooling or joint tooling, and before initial set of the surface pavement, the pavement shall be given a textured finish perpendicular to match the existing. The textured finish shall be accomplished by a steel tine tool that will mark the finished pavement to a depth of 1/8 inch plus or minus 1/16 of an inch. Match finish of existing pavement where new pavement is adjacent. The surface of the pavement shall not vary from a true surface, when tested with a 12 foot testing straightedge, more than 1/8 inch in 12 feet.

C. Finish shall be a light broom finish for slip resistant surface. Broom pattern to be parallel to slope.

D. Accessible Ramps: Steel trowel finish. Apply tactile warning finish.

3.6 JOINTS

A. Construction joints, expansion joints, transverse contraction joints, and all longitudinal contraction joints shall be placed as indicated in the drawings.

B. Contraction Joints:

1. Longitudinal contraction joints shall consist of planes of weakness created by forming grooves in the surface of the pavement.

2. Maximum joint spacing shall be 5 feet for sidewalks, and as shown on drawings for other work.

C. Construction Joints: Construction joints shall be placed whenever the placing of concrete is suspended for more than 45 minutes. A butt joint with dowels or a thickened-edge joint shall be used if the joint occurs at the location of a contraction joint.

3.7 SEALING JOINTS

A. Seal joints for curbs, gutters, and walks in conformance with Section 32 13 73, CONCRETE PAVING JOINT SEALANTS.

B. Saw cut sealant reservoir for pavement joints using a double cut per the details shown on the construction drawings. Clean reservoir, prepare joints, install backer rod and sealant all in strict accordance with the recommendations in the joint sealant manufacturer's installation or application guide and in accordance with the appendix to ASTM D5893 (latest revision) (if using silicone sealant).

C. Joints to be sealed shall be filled with joint-sealing material before the pavement is opened to traffic and as soon after completion of the curing period as is feasible.

D. Each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound, and joint faces shall be clean and surface-dry when seal is applied.

3.8 WALK EDGING

A. Before final finishing is completed and before final concrete set has occurred, finish concrete edges with edging tool shaped with 1/4 inch radius.

1. Take particular care to maintain surface on both sides of joint in same plane.

2. Do not use kneeling planks on concrete surface.

3.9 CURING

A. Minimum Curing Period: 3 days.

B. Uniformly apply compound in accordance with manufacturer's instructions, after final Concrete finishing is complete, and after all free water has disappeared from pavement surface.

C. Apply to concrete edges immediately after formwork removal.

D. Do not use membrane compound method if pavement will be exposed to de-icing chemicals within 30 days following curing period completion.

3.10 FIELD QUALITY CONTROL

A. Refer to Section 01 45 00 for responsibilities for arranging, supervising, and payment of field quality control requirements.

B. Field Tests:

1. Observance and approval of subgrade and base rock compaction.

2. Concrete cylinder strength tests. Concrete flexural strength tests.

3. Slump and air tests.

C. Field Inspections: Notify Engineer prior to work of this section.

D. Special Inspections for Code Compliance: Obtain building inspector approvals.

3.11 DEFECTIVE WORK

A. Remove and replace any surfaces which show excessive cracks, pavements that do not drain properly, and other defective concrete.

B. Minimum Surface Evenness: 1/8 inch per 10 ft.

3.12 CLEANING

A. Including work of other trades, clean, repair and touch-up, or replace when directed products which have been soiled, discolored, or damaged by work of this section.

B. Upon completion of the work of this section, promptly remove from the working area all scraps, debris, and surplus material.

3.13 PROTECTING COMPLETED WORK

A. Protect all work installed under this section.

B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

PARKING BUMPERS

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, material, equipment, and services necessary for the installation of precast concrete wheel bumpers.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM).

1.3 PROJECT CONDITIONS

A. Verify that substrates are adequately clean for application of grout.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Product Manufacturers: Michael PreCast Concrete Specialties, 35175 S.E. Highway 211, Boring, OR 97009, 503/668-4073.

B. Other Manufacturers: Submit Substitution Request prior to bid date in accordance with Division 1 Section “Product Requirements.”

2.2 MATERIALS

A. Provide 6-foot long precast concrete wheel bumpers.

1. Portland Cement: Conform to ASTM C150, Type I or III.

2. Concrete Aggregates: Conform to ASTM C33.

3. Reinforcement: Conform to ASTM A615, Grade 40.

B. Grout: Use either non-shrink grout specified in Division 3 Section “Grouts,” or two component epoxy adhesive equal to “Concressive 1064.”

PART 3 EXECUTION

3.1 INSTALLATION

A. Apply grout or adhesive to substrate, sufficient to cover 80% of wheel bumper contact area after installation.

B. Place wheel bumpers in position and anchor at each end with No. 4 reinforcing bar at least 10 inches long. Drive in 1 inch below top of bumper.

C. Fill anchor hole with grout. Finish surface to match bumper.

END OF SECTION

PAINTED PAVEMENT MARKING

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and services necessary for the installation of traffic lane and parking stall striping, handicap symbols painting, and directional word and directional arrow painting.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO).

1.3 SUBMITTALS

A. Submit the following in accordance with Division 1 Section “Submittal Procedures.”

B. Product data sheets with surface preparation, application instructions, and clean-up information.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not apply marking paint when wind velocity exceeds 15 mph.

B. Do not apply marking paint when pavement temperature is less than 40°F, and ambient air temperature is less than 45°F.

1.5 SCHEDULING

A. Perform pavement marking work after installation and curing concrete curbs, and walks.

B. Perform pavement marking work after curing and sealing asphaltic concrete pavement.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Traffic Marking Paint:

1. Fuller O'Brien: Traffic Line Paint, 382 Series, white, yellow, and blue.

2. General: Tru-Test Supreme Zone Marking Paint, white, yellow, and blue.

3. Miller: Acrylic Traffic Zone Paint, 8000 Series, white, yellow, and blue.

4. PPG Industries: Pittsburgh Traffic and Zone Marking Paint 22 Line, white, yellow, and blue.

5. Rodda: Traffic Paint, white, yellow, and blue.

6. Sherwin-Williams: Setfast Series, low VOC acrylic, white, yellow, and blue.

B. Other Manufacturers: Submit Substitution Requests prior to bid date in accordance with Division 1 Section "Product Requirements."

2.2 MATERIALS

A. Paint shall comply with industry standard AASHTO M248, Type 3F.

2.3 EQUIPMENT

A. Apply paint with motor powered atomizing spray striping machine.

B. Adjust pavement marking equipment controls to level required to apply required mil thickness.

PART 3 EXECUTION

3.1 PROTECTION AND PREPARATION

A. Protection: Place temporary barricade and rope or plastic cone barriers to keep vehicular traffic off striping until paint is dry.

B. Surface Preparation:

1. Pressure wash pavement surface and blow dry wet areas prior to applying paint.

2. Architect will review line and symbol layout prior to starting striping work.

3.2 PAVEMENT STRIPING

A. Spray-apply paint with straight edges, true alignment, and uniform wet film thickness of 17 mils with thickness variation not to exceed 2 mils.

B. Form handicap symbols, words, and arrows with templates. Handicap symbols shall be white with blue background.

C. Apply white paint to pavement areas.

D. Apply yellow paint to curbs and no parking striped pavement areas.

E. Apply parking area striping in 4-inch-wide lines.

3.3 ADJUSTING

A. Remove misplaced marking paint from concrete surfaces.

B. Cover misplaced paint on asphaltic concrete with asphalt emulsion.

END OF SECTION

SEGMENTAL RETAINING WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Segmental retaining walls made of modular concrete units with or without soil reinforcement.

1.2 RELATED REQUIREMENTS

A. Section 01 41 00 - Testing Laboratory Services.

B. Section 31 23 16 - Excavation.

C. Section 31 23 23 - Fill.

D. Section 33 44 00 - Storm Drainage Utilties.

1.3 SUBMITTALS

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

B. Submit the following:
   1. Product Data: Material description and installation instructions for each manufactured product specified.
   2. Shop Drawings: Retaining wall system design, including wall elevations, geosynthetic reinforcement layout, pertinent details and drainage provisions.
   3. Samples:
      a. Furnish one unit in the color and face pattern specified.
      b. Furnish 12-inch square or larger piece of geosynthetic reinforcement specified.

C. Installer Qualification Statement.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Firm specializing in design and installation of segmental retaining walls and:
   1. With not less than 2 years documented experience.
   2. With a minimum of five previously constructed successful projects, similar in size and magnitude, using specified retaining wall system; provide contact names and numbers.

1.5 MOCK-UP

A. Prior to erection of retaining walls, provide mock-up for evaluation of installation workmanship.

B. Erect 4 by 4 ft sample wall using materials specified.

C. Locate mock-up where directed by Landscape Architect.

D. Do not start masonry work until mock-up has been approved by Landscape Architect.

E. Retain mock-up during construction as standard for judging completed work. Do not alter or destroy mock-up until work is completed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products above ground on wood pallets or blocking, in manufacturer's unopened packaging, until ready for installation.

B. Prevent excessive soil and mud from coming in contact with face of concrete units.

C. Protect material from damage. Do not use damaged material. Remove damaged material from the site.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 EXTRA MATERIALS

A. Furnish Owner with five replacement wall units and five replacement cap units identical to units installed under this Contract.

1.8 CONSTRUCTION TOLERANCES

A. Site Construction Tolerances
   1. Vertical Alignment: Plus or minus 1 ½ inches over any 10 feet distance, with a maximum differential of 3 inches over the length of the wall.
   2. Horizontal Location Control
      a. Straight Lines: +/- 1 1/2 inches over any 10 feet distance.
      b. Corner and Radius Locations: +/- 12 inches.
      c. Curves: +/- 2 feet.
   3. Post Construction Batter: Within two degrees of the design batter of the retaining wall unit.
   4. Bulging: +/- 1 ¼ inches over any 10 feet distance.

1.9 FIELD QUALITY CONTROL

A. The Owner will employ independent testing services of the installed work of this Section as specified in 014000.

B. Correct work that does not meet these specifications or the requirements shown on the Drawings.

C. Perform compaction testing of reinforced backfill placed in reinforced backfill zone.
   1. Testing Frequency:
      a. One test every two vertical feet of fill placed and compacted for every 50 lineal feet of wall.
      b. Vary compaction test locations to cover entire area of reinforced soil zone

PART 2 PRODUCTS

2.1 CONCRETE RETAINING WALL UNITS

A. Anchor Highland Retaining Wall Unit by Anchor Wall Systems. Mfg. rep: Willamette Graystone, Eugene, OR (541) 726-7666; or approved equal.
   1. Meet requirements of ASTM C1372
      a. Large unit nominal dimension: 6” x 18” x 12”
      b. Medium unit nominal dimension: 6” x 12” x 12”
      c. Small unit nominal dimension: 6” x 6” x 12”
      d. Unit Cap: 3”x17.25”x10”.
      e. Color: Granite
      f. Face pattern geometry: Straight
      g. Texture: Split-face
      h. Include integral concrete shear connection flange/locator.

2.2 GEOSYNTHETIC REINFORCEMENT

A. Polyester fiber geogrid or geotextile, or polypropylene woven geotextile.
   1. Miragrid 3XT by MIRAFI or approved equal.

2.3 LEVELING PAD BASE

A. Base Course: Specified in Section 31 20 00

2.4 DRAINAGE AGGREGATE

A. Drainage Course: Specified in Section 31 20 00

2.5 BACKFILL

A. Satisfactory Soils: Specified in Section 31 20 00

2.6 IMPERVIOUS MATERIAL

A. Clayey soil or other impervious material which will prevent percolation into the drainage zone behind the wall.

2.7 DRAINAGE PIPE

A. Perforated drain pipe: Specified in Section 33 40 00.

2.8 CONSTRUCTION ADHESIVE

A. Exterior grade adhesive as recommended by the retaining wall unit manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

A. General
1. Prior to installation of work this Section, carefully inspect the installed work of others and verify that all such work is complete to the point where this installation may properly commence.
2. Do not install work of this Section until all unsatisfactory conditions have been corrected. Commencing work denotes acceptance of existing conditions.
3. Follow manufacturer's recommendations for installation and in accordance with Drawings.

B. Excavation
1. Excavate to lines and grades shown on drawings.
2. Do not disturb embankment or foundation beyond lines. Minimize over-excavation; fill over-excavated areas with compacted reinforced backfill or leveling pad material at Contractor's expense.
3. Excavate foundation soil as required for footing or base dimensions shown on Drawings. Compact soil to a density equal to requirements of subsequent material. Coordinate testing services and obtain approval prior to placing base pad.
4. Fill over excavation with suitable compacted backfill as directed by Landscape Architect.

C. Base Course Installation
1. Place base pad material to depths and dimensions shown on Drawings, compacted to 6 inch minimum depth.
2. Compact aggregate base to provide a level, hard surface on which to place the first course of concrete units.
3. Prepare base materials to ensure complete contact with retaining wall units. Gaps are not allowed.

D. Erection
1. Erect units in strict accordance with manufacturers instructions and recommendations, as shown on Drawings, Details, and as specified herein.
2. Place first course of units on prepared base, check for level. Maintain same elevation at top of each unit within each section of base course. Place wall units side-by-side for full length of wall alignment. Use string line from back of wall as required. Gaps are not allowed between the foundation concrete wall units.
3. Place 12" minimum drain rock between and directly behind units. Provide a drainage zone behind the wall units to within 9 inches of final grade. Cap the backfill and drainage aggregate zone with 9 inches of impervious material.
4. Install drainage pipe as indicated on Drawings.
5. Remove excess fill from top of units and install additional wall unit courses. Insure drainage aggregate and backfill are compacted prior to subsequent wall installation. Check each course for level and alignment. Adjust units as necessary to maintain level and alignment prior to proceeding with additional course. Backfill as each course is completed. Pull units forward until the locating surface of the unit contacts the locating surface of the preceding course. Interlock units that meet at corners by overlapping successive courses. Attach wall units at exterior corners with specified adhesive.
6. Vary wall patterns with changes in unit size. Obtain approval of Landscape Architect. Patterns can be incorporated into the wall system.

E. Install geosynthetic reinforcement in accordance with geosynthetic manufacturer's recommendation and shop drawings. Install reinforcement only when wall height exceeds 48 inches.
   1. Orient geosynthetic reinforcement with highest strength axis perpendicular to the wall face.
   2. Prior to geosynthetic placement, place backfill and compact to the elevation of top of wall where reinforcement is to be placed. Place material at elevations and lengths shown on Drawings.
   3. Lay geosynthetic on top of wall to within one inch of face of unit. Place next course of wall unit on top of geosynthetic.
   4. Keep geosynthetic in tension and free from wrinkles prior to placement of backfill. Pull geosynthetic taut and secure with stakes, staples or hand-tension until placing 6" minimum loose fill. Geosynthetic to be continuous throughout embedded lengths. Splices are not allowed.

F. Place backfill in manner that will minimize slack in reinforcement material. Place fill and compact in lifts not exceeding 8 inches (loose thickness) where hand operated compaction equipment is used. Compact to 95 percent of soil's standard Proctor maximum dry density.

G. Hold backfill down depth of topsoil below final elevations at top of walls. Grade subsoil backfill to slopes indicated on Drawing. Final backfill shall be 18 inch Loam as specified in 02200.

H. Cap Installation
   1. Apply adhesive to top of final wall units at stepped elevations. Place cap unit into desired position.
   2. Cut cap units as necessary to obtain proper fit.

I. Adjusting and cleaning
   1. Replace damaged units with new units as work progresses.
   2. Upon completion of work of this Section promptly remove from the working area all scraps, debris and surplus material of this Section.

3.2 PROTECTION

A. Prevent damage to wall and earthwork by subsequent construction and uncontrolled runoff until substantial completion; repair damage due to failure to protect wall or earthwork.

B. Do not operate heavy paving or grading equipment within 36 inches from the back of the wall face.

C. Do not operate equipment with wheel loads in excess of 150 psf live load within 10 feet from the wall face.

D. Do not place temporary soil or fill stockpiles adjacent to wall.

E. Replace damaged units prior to substantial completion.

END OF SECTION

IRRIGATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of Central Control system, control wires, shrub and lawn zones.

1.2 RELATED REQUIREMENTS

A. Section 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

B. Section 01 60 00 - Product Requirements

C. Division 26 - Electrical

D. Division 31 - Earthwork

E. Section 32 90 00 - Planting

1.3 REFERENCE STANDARDS

A. ASTM D1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

B. ASTM D1785: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

C. ASTM D2464 - Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

D. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

E. ASTM D 2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2004 (Reapproved 2009).

1.4 PROTECTION

A. Protect existing improvements and growth in areas to remain undisturbed until completion of project. Leave area in similar condition as found.

B. Protect utilities and maintain in continuous operation or in operational condition during work. Repair damage to known utilities at Contractor's expense.

C. Use means necessary to protect materials of this Section before, during, and after installation and to protect installed Work and materials of other trades. In the event of damage immediately make repairs and replacements as directed by Owner's Representative.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with other trades affecting and affected by Work of this Section.

B. Preinstallation Meeting: Convene one week (minimum) prior to commencing work of this Section to coordinate utility marking procedures.

1.6 SUBMITTALS

A. See Section 01 60 00 - Product Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's printed data covering products and installation instructions.

C. Quality Assurance Data: Submit license information and project references including name and location of previous projects, date of installation, square footage of areas with irrigation work, description of irrigation system, and Owner's contact information.

D. Record Documents: Record actual locations of installed irrigation components on a clean set of plans. Use white out and red ink to legibly re-draft as-built information.

1. Produce and keep current throughout the project.

2. Indicate two dimensions for valves, stub outs, and main line T's, L's, ends, elbow's, and change in direction.

3. Submit to Owner's Representative for approval.

E. Operation and Maintenance Data:

1. Provide written instructions at System Demonstration for operation and maintenance of system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.

2. Submit chart showing actual precipitation rates for each zone.

3. Prepare a program for the irrigation controller for Spring/Summer; Summer; Summer/Fall using historical weather data and averages. Include start times, watering duration, day of week, repeat cycle mode, program mode, precipitation rates in inches per hour, and application quantities. Coordinate operation and programming with Owner's Representative.

1.7 **QUALITY ASSURANCE**

A. Installer Qualifications: Company specializing in performing Work of this Section who has successfully completed a minimum of 5 comparable scale projects and have the following licenses:

1. For Irrigation Work:
   a. Valid Oregon Landscape Contractors license.
   b. Valid Oregon Landscape Business license.

2. For Plumbing Work:
   a. Valid Oregon Plumbing license.
   b. Valid Oregon Landscape Contractor license.

3. Successfully completed at least 5 comparable scale projects.

a. Submit names, addresses, dates, owners and locations of previous projects if requested by Owner's Representative.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original unopened packaging with legible manufacturer's identification.

B. Comply with manufacturer's recommendations for storage and protection.

1. Store in a cool, dry place out of direct sunlight.

2. Protect from damage by the elements and construction procedures.

3. Store plastic pipe on firm, level supports.

4. Store plastic pipe cement in cool location.

1.9 ENVIRONMENTAL CONDITIONS

A. Temperature of mating surfaces of plastic pipe and fittings to be between 40 degrees fahrenheit and 100 degrees fahrenheit. Perform no PVC Solvent welding in rainy weather except under cover.

1.10 REVIEWS

A. Request the following reviews by the Owner's Representative two days (min.) in advance:

1. Irrigation Head Layout Review

2. Pressure Test and Main Line Installation

3. System Review

4. System Demonstration to Owner

B. Coordinate Reviews to coincide with regular progress meetings where possible.

1.11 MAINTENANCE

A. During period between system installation and Final Acceptance provide maintenance to assure proper operation of the irrigation system.

1.12 WARRANTY

A. Warranty period shall be one year following Final Completion or one full operating season following Final Completion, whichever is longer.

B. Contractor guarantees materials furnished under this Contract will be as specified and the Work will be free of defects in compliance with the Contract Documents.

C. Irrigation system must be in proper working condition at the end of the warranty period. At no additional cost to the Owner replace Work of this Section as necessary to restore system to proper working condition following the Contract Documents.

D. Visit and inspect Work at least once a month during warranty period and notify Owner's Representative in writing of any observed conditions requiring attention. Failure to provide such notification renders deficiencies the Contractor's responsibility to rectify.

E. Contractor is not responsible for loss or damage to Work of this Section caused by unusually extreme weather, vandalism, or lack of Owner's maintenance during warranty period.

PART 2 PRODUCTS

2.1 IRRIGATION SYSTEM MATERIALS

A. Use only new materials of brands and types shown on Drawings or specified herein.

B. Similar materials must be products of one manufacturer unless otherwise approved.

C. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PIPE MATERIALS

A. Main Line Pipe: Schedule 40 PVC Pipe, Type 1, normal impact: IPS, NSF approved conforming to ASTM D1784, ASTM D1785.

B. Lateral Line Pipe: Schedule 40 PVC Pipe, Type 1, normal impact: IPS, NSF approved conforming to ASTM D1784, ASTM D1785.

C. Risers: One piece schedule 80 gray PVC Pipe, Type 1, threaded at both ends conforming to ASTM D1784 and ASTM D2464. No snap-risers.

D. Fittings: Polyvinyl chloride type 1, white schedule 40 and gray schedule 80; ASTM D1784, ASTM D2466, or ASTM D2464, as applicable.

E. Irrigation Sleeves: Schedule 40 PVC Pipe, Type 1, normal impact: IPS, NSF approved conforming to ASTM D1784, ASTM D1785.

F. Swing Joint Assembly Pipe and Fittings: Double swing joint risers as detailed. Swing-Pipe, snap, and "Funny pipe" risers not acceptable.

G. Flex Riser Assembly: 18 inch minimum, 3 feet maximum Swing-Pipe with transfer barb 90 degree ells at both ends and a marlex ell below the irrigation head.

H. Electrical Conduit and Fittings:

1. Underground: Plastic, Class 3, Federal Specification W-C-1094.

2. Above Ground: Aluminum, Federal Specification WW-G-540.

I. PVC Solvent Cement: NSF approved solvent for Class 1245-B&C PVC through 4 inches conforming to ASTM D 2564 for PVC pipe and fittings. Ensure that manufacturer's expiration date is not exceeded.

1. At main lines: IPS Corporation Weld-On #705 PVC.

2. At lateral lines: IPS Corporation Weld-On #705 PVC or #721 PVC.

J. PVC Cleaner and Primer:

1. IPS Weld-on P-70 or as recommended by PVC Pipe manufacturer.

2. Oatey Lo-V.O.C. Purple Primer #31903.

2.3 VALVES

A. Isolation Valves - 3 inch and under: Threaded gate valve with resilient wedge sized to match mainline with wheel handle.

1. Approved Products: Kennedy model 8057, or approved.

B. Isolation Valves - over 3 inches: Flanged gate valve with resilient wedge sized to match mainline with wheel handle.

1. Approved Products: Kennedy model 8561, or approved.

C. Control Valve Assembly:

1. Automatic Control Valve: Globe type, 200 psi rated, threaded connections with cross type operating handle designed to receive operating key. Size according to Valve Schedule on Drawing.
   a. Approved Products: Toro P-220-27 Series, or approved. Include EZ Reg (pressure regulating system).

2. Shut Off Valve: USA manufactured gate valve. 135 psi cold water rated constructed of brass or bronze on 2 inch and under valves with bronze wheel handle.
   a. Approved Products: Nibco T-113, or approved.

D. Quick Coupling Valves: Rain Bird 44 RC, or approved.

E. Master Valve: 24V AC, normally open and flanged at both ends; Size: 2 inch.

1. Approved Products: Model 410 by Bermad Manufacturer, or approved.

F. Flow Sensor: PVC tee type sensor.

1. Approved Products: Model TFS-150 by Toro, or approved.

G. Manual Drain Valve: Globe or angle brass manual valve with non-floating seat disk that allows positive drainage.

1. Approved Products: Manufactured by Arrowhead, or approved.

2.4 VALVE BOXES

A. Valve box of suitable size with tee top type lid . Green box and lid.

B. Install valves in the following valve boxes:

1. Control Valve Assembly: (2) Carson 1419-12, T-Lid.

2. Quick Coupling Valves: Carson 910-10, T-Lid.

3. Manual Drain Valves: Carson 910-10.

4. Isolation Valves: Carson 910-10.

5. Other Valves: Sized as applicable by Carson.

2.5 IRRIGATION HEADS

A. Makes and models shown on Drawings, or approved.

2.6 WIRE

A. Zone Control Wire: Install according to manufacturer's wire schedule for valve specifications. 14 gauge minimum, type AWG-UF, bearing U.S. approval.

B. Communication Wire: Install according to manufacturer's central control requirements. Wire from controller to flow sensor must be a single, unspliced length.

1. 14 gauge, PE 39 cable, 6 pair

2. Sentinel, or approved.

C. Wire Connections: Direct bury splice Kit.

1. DBR/Y by 3M.

2. Scotch Lok 3570.

D. Utility Locate Wire: 14 gauge minimum, type AWG-UF, bearing U.S. approval, blue in color.

2.7 RETRO LINK ASSEMBLY (FOR RAINBIRD CONTROLLERS)

A. Two (2) each Toro RLS-RB Sentinel Retro - Link Assembly. Deliver to Owner.

2.8 BACKFILL MATERIALS

A. Pea Gravel: 3/4 x 1/2 inch washed round rock.

B. Sand: Clean, fill sand free of clay, rocks, organic matter, or other deleterious material.

C. Topsoil or Loam: See Section 32 90 00 - Planting.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that required utilities and sleeves are available, in proper location, and ready for use. Verify location, type, size, psi, and GPM of existing water lines, meters, and sleeves.

B. Verify that surfaces and structures to receive Work are accurately sized and located, sound, secure, true, complete, and otherwise properly prepared.

C. Verify electrical service and conduit for Irrigation Controller is properly sized and located.

3.2 PREPARATION

A. System layout is diagrammatic. Route piping to avoid plants, ground cover, and structures. If field measurements differ slightly from Drawings modify work for accurate fit. If measurements differ substantially notify Owner's Representative prior to installation.

B. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system and piping to minimize conflict with other work.

C. Coordinate connections to existing irrigation system, including system shut down, new connections, system re-start, and scheduling of new irrigation zone run times with Owner's Representative.

D. Irrigation Head Layout Review: Install flags at locations of irrigation heads and components shown on Drawings. Obtain Owner's Representative's approval and make adjustments to locations as directed. Coordinate marking of pipe trenches and location of valves prior to executing Work.

3.3 CUTTING OF PAVEMENT AND REPAIR

A. Do no cutting of pavement for installation of Work without Owner Representative's approval.

3.4 MASTER VALVE AND FLOW SENSOR INSTALLATION

A. Install where shown on Drawings in accordance with manufacturer's directions when making supply and central control component connections.

3.5 TRENCHING

A. Excavate trenches with uniform bottom and remove rocks and sharp objects to provide firm, even, clean base for pipe. Width of trench to be 1.5 times the outside diameter of the pipe.

B. Trench Depth:

1. Minimum Cover Over Installed Mainline Piping: 18 inches.

2. Minimum Cover Over Installed Lateral Line Piping: 12 inches.

3. Minimum Cover Over Installed Sleeves at other paving: 6 inches from bottom of paving.

C. More than one pipe is permitted in the same trench provided that:

1. Two pipes may be stacked vertically if 4 inches of Sand separates them.

2. Three or more pipes must be laid 4 inches apart horizontally.

D. Where excavation is performed to excess levels backfill with Sand to proper levels.

E. Keep trenches dry and frost free. Provide and operate pumping equipment to keep excavations free from standing water.

F. Protect existing vegetation to remain. Cut no roots over two inches in diameter without approval of Owner's Representative. Make cuts clean, straight, at right angles to roots. Paint cuts over 1-1/2 inches diameter with approved tree paint. Repair or replace damaged plant material.

3.6 SLEEVE INSTALLATION

A. Sleeves may be jacked or pulled but cover requirements must be maintained. Jacking of PVC pipe is not permitted in rocky or bar run fills where there is potential for damage to pipes.

B. Extend sleeves 12 inches beyond pavement edge or curb.

C. Install level and perpendicular to sidewalks and pavement unless shown otherwise on drawings.

D. Provide markers where sleeve ends are concealed.

3.7 PIPE BEDDING

A. Main Line: Provide uniform bearing surface of Sand, 4 inches minimum depth, free of rocks and sharp objects under entire length of pipe.

B. Lateral Line: Provide uniform bearing surface of clean topsoil, loam, or Sand. If rock or other deleterious materials are encountered bed pipe with 4 inches of Sand on all sides.

3.8 PIPE INSTALLATION

A. Irrigation lines may be jacked or pulled but cover requirements must be maintained. Jacking of PVC pipe is not permitted in rocky or bar run fill or where there is potential damage to pipes.

B. Install pipe in accordance with manufacturer's instructions and with the following minimum clearances around pipe:

1. 2 inch diameter and smaller: 2 inches

2. 2-1/2 inch diameter and larger: 4 inches

3. Between irrigation and other utilities: 1 foot

C. Threaded Plastic Pipe Installation:

1. Do not use solvent cement on joints.

2. Wrap threaded joints with teflon tape. Minimum 4 wraps of tape.

D. Cemented Plastic Pipe Installation:

1. Cut ends square using approved pipe cutter and bevel cuts with deburring tool.

2. Clean pipe of scale, sand, dirt, etc. prior to assembling.

3. Avoid using an excess amount of primer and cement when making joints; particularly on the inside of female pipe ends and fittings.

4. Wipe off excess cement continuously as it appears on the surface of the pipe after making joints.

5. Allow fifteen minutes of cure time on joints before moving or handling. Assemble pipe before lowering into trench.

6. Snake lines to allow for contraction.

7. Transition pipe sizes at fittings and not bell end of pipes.

8. Install thrust blocks at 90 degree corners and tees.

3.9 THRUST BLOCK INSTALLATION

A. Install 2500psi thrust block at pipe corners, tees, ells, and stub outs.

1. Pipe 2 - 3 inches in diameter: 1 cubic foot.

2. Pipe larger than 3 inches in diameter: 2 cubic feet.

3.10 VALVE INSTALLATION

A. Install plumb and square, as detailed, and according to manufacturer's specifications.

B. Manual Drain Valves:

1. Install at mainline low points and at outlet of control valves where laterals run uphill.

2. Record locations on as-built drawings.

C. Install 1 valve in each valve box assembly.

D. Valve Sump: Install a minimum of 2 cubic feet of Pea Gravel below each valve. Allow for 4 inches clearance between bottom of valve and valve sump.

3.11 VALVE BOX INSTALLATION

A. Install plumb and square with adjacent construction with one valve in each valve box assembly.

B. At Control Valve Assemblies bolt two valve boxes together as detailed.

C. Permanently label valve type and zone number on inside of valve box lid.

D. Set top of valve boxes flush with lawn or mulch at plant beds unless otherwise noted.

E. Provide 12 square inches (min.) of support on each side of valve box as detailed.

3.12 CONTROL WIRE INSTALLATION

A. Install wires below irrigation mainline with multiple wires bundled together at 5 foot maximum intervals in a continuous run. Notify Owner's Representative for approval prior if splices are required and locate in valve box.

B. Use coded and labeled wires for each valve. Provide a numbered tag at each end of a wire at valve, and at controller. The number at each end of wire to be the same.

C. Provide 48 inches loop in wires at each valve where controls are connected and at 100 foot maximum intervals between. Coil wire around 1/2 inch rebar dowel inside of valve box.

D. Make electrical joints waterproof using specified connectors. Enclose joints in valve boxes.

E. Install wire in continuous runs with no splices unless approved.

F. Show wire routes and approved splice locations on As-Built drawings.

G. Install wires above grade or independent of the mainline in conduit.

3.13 MAIN LINE PRESSURE TEST AND INSPECTION

A. Prior to backfilling and installing valves test irrigation mainline for leakage. Establish and maintain 100 psi pressure for 24 hours. Perform test a minimum of 24 hours after set-up of solvent weld. Notify Owner's Representative a minimum of 24 hours for review of pressure gauge at beginning and end of test period. Mainline will be accepted if pressure loss is less than 2 psi.

B. Following the pressure test but prior to backfilling, notify Owner's Representative for review of pipe, fittings, joints, thrust blocks, bedding, control wire installation, valves, and other materials for installation and water tightness.

C. After successful pressure test and main line inspection begin backfilling and assembly of zones and system components.

3.14 BACKFILLING

A. Remove debris, sharp rocks, and diameter matter from areas to be back filled before proceeding.

B. Main Lines: Provide 6 inch Sand cover over piping then place Utility Locate Wire the entire length of pipes where control wires are not present. Backfill remainder of trench with Topsoil or Loam.

C. Lateral Lines: Backfill trench with Topsoil or Loam. Protect piping from displacement.

D. At Paved Areas: Backfill trench with Sand under paved areas.

E. Compact backfill in 6 inch lifts to match density of surrounding material. Install backfill to match adjacent elevations.

3.15 FLUSHING

A. Main line: Open valves and thoroughly flush piping system under full water head after piping, risers, and valves are installed. Maintain flushing for three minutes. Close valves and cap risers immediately after flushing.

B. Second Flushing: Flush a second time after installation of lateral lines and sprinklers prior to nozzle installation. Flush under full water head for three minutes. Install nozzles after flushing.

C. Drip Line Flushing: Remove flush cap and flush each zone under full water head after all connections have been made. Maintain flushing for three minutes and immediately replace flush cap.

3.16 SPRINKLER HEAD INSTALLATION

A. Install plumb with top of Topsoil/Loam or Mulch as detailed and at locations shown on drawings. Allow a maximum of 3 inches clearance between sprinkler head and adjacent lawn or planting edge.

B. Install 1 cubic foot Pea Gravel sump on all low irrigation heads where drainage occurs at zone shutdown.

3.17 SYSTEM REVIEW

A. Prepare and start system in accordance with manufacturer's instructions. Prior to notifying Owner's Representative for review of the system review zones and make adjustments to ensure full and even coverage.

B. Notify Owner's Representative for review of system operation to determine if water afforded to all areas is complete, adequate, and uniform.

C. Adjust system for full water coverage as directed.

3.18 SYSTEM DEMONSTRATION TO OWNER

A. Instruct Owner's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance data as basis for demonstration.

3.19 CLEANING

A. Remove excess excavation, backfill materials, and other left over materials from the site. Clean improvements soiled by Work of this Section.

END OF SECTION

PLANTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparation of subsoil.

B. Soil Material placement.

C. New trees, plants, and ground cover.

D. Mulch and Fertilizer.

1.2 RELATED REQUIREMENTS

A. Section 01 56 39 - Temporary Tree and Plant Protection.

B. Section 01 60 00 - Product Requirements.

C. Section 01 70 00 - Execution and Closeout Requirements.

D. Section 31 20 00 - Earth Moving.

E. Section 32 80 00 - Irrigation.

1.3 DEFINITIONS

A. Weeds: Any plant life not specified or scheduled. Includes seeds and roots.

B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.4 REFERENCE STANDARDS

A. Quality definitions, grading tolerances, root system condition, caliper height, branching, budding: ANSI/ANLA Z60.1 - American Standard for Nursery Stock, latest edition.

B. ANSI A300 Part 1 - American National Standard for Tree Care Operations -- Tree, Shrub and Other Woody Plant Maintenance -- Standard Practices; 2001.

1.5 Protection

A. Protect existing improvements and growth in areas to remain undisturbed until completion of project. Leave in similar condition as found.

B. Maintain benchmarks, monuments, and other reference points. Replace if disturbed or destroyed.

C. Contact local utility companies for verification of the location of underground utilities within the project area prior to starting excavation. Protect utilities and maintain in continuous operation or in operational condition during work. Repair damage to known utilities or related facilities in an approved manner at Contractor's expense.

D. Protect drainage inlets and underground drain lines from infiltration or clogging by soils and mulch during construction until Final Completion.

E. Protect materials of this Section before, during, and after installation. Protect installed work and materials of other trades. In the event of damage make repairs to like new condition. If products are not repairable to like new condition provide replacement.

1.6 SUBMITTALS

A. Maintenance Data: Include written instructions covering yearly recommended maintenance and care of plantings including fertilization, pest and disease control, weed control, mulching, and pruning.

B. Quality Assurance Data: Submit license information and project references including name and location of previous projects, date of installation, square footage of areas with planting work, and Owner's contact information.

C. Submit list of plant life sources within 14 calendar days of Agreement Date.

1. Submit confirmation from supplier(s) that specified plant materials, meeting the specifications, have been secured. Include plant name, quantity, size, condition, and name of supplier.

D. Product Data: Submit manufacturer's printed data for products and a list of suppliers.

E. Sample: Submit a 2 quart sample of Soil Material with supplier's name and specific location of source. Approval of Soil Material by Owner's Representative is required prior to delivery to the site.

F. Invoices: Within 2 days of delivery submit invoices, load tickets, and truck measures for Soil Material, Organic Material, and Mulch. Landscape areas will not be accepted until invoices are received by Owner's Representative.

1.7 QUALITY ASSURANCE

A. Valid Oregon Landscape Contractor's license.

B. Valid Oregon Landscape Business license.

C. Herbicide applicators must have valid State of Oregon Herbicide Applicator's license.

D. Installer Qualifications: Company specializing in installing and planting the plants with 5 projects of comparable scale successfully completed.

1. Submit names, addresses, and dates of previous projects, owners.

1.8 COORDINATION

A. Coordinate with other trades affecting and affected by Work of this Section.

B. Pre-Installation Conference: Attend conference to coordinate Work of this Section and other related Sections.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

B. Protect and maintain plant life until planted.

C. Deliver plant life materials immediately prior to placement. Keep plants moist.

D. Deliver products in original unopened packaging with legible manufacturer's identification.

E. Seed containers shall show manufacturer's guaranteed analysis of seed mixture, percentage of purity, year of production, date and location of packaging, name and trademark, and conformance with governing regulations.

F. Plants may be rejected if:

1. Ball of earth surrounding roots has been dried out, cracked, or broken.

2. Burlap, staves, wire baskets, or ropes required in connection with transplanting have been displaced.

3. Grower or nursery identification labels have been displaced prior to acceptance.

1.10 ENVIRONMENTAL CONDITIONS

A. Do not install plant life when ambient temperatures is below 32 degrees F or above 90 degrees F, wind velocity exceeds 30 mph, or the soil becomes saturated.

B. Install plant materials during periods which are normal for such work as determined by the biological season, specified environmental conditions, and after all major construction work has been completed.

C. Planting Seasons:

1. Trees: Bare root trees may be planted only between January 15th and March 15th unless otherwise approved.

2. Seeding: Permitted between April 15 and October 15 unless otherwise approved.

3. Other: Permitted during any period, except when prohibited by other portions of this Section.

1.11 Reviews

A. Request the following reviews by the Owner's Representative a minimum of 2 days in advance:

1. Subgrade preparation

2. Soil Material placement

3. Finish grading

4. Plant materials

5. Plant material layout

6. Planting mock-up

7. Completion

B. Coordinate all reviews to coincide with regular progress meetings where possible.

1.12 RECORD DOCUMENTS

A. Produce, keep current, and submit legible record documents on a clean set of plans and details supplied by the Owner's Representative. Use white-out and red ink to legibly re-draft actual locations of installed work.

1.13 WARRANTY

A. Provide one year warranty following Final Completion or one full growing season following Final Completion, whichever is later.

B. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

C. Inspection: Visit work at least once a month during warranty period. Notify Owner's Representative and Owner in writing of any observed conditions requiring attention. Failure to provide such notification renders any deficiencies the Contractor's responsibility to rectify.

D. At the end of the warranty period, as directed by Owner's Representative and at no additional cost to the Owner:

1. Replace work not surviving, in poor condition, or not exhibiting satisfactory growth.

2. Lawns must be healthy, dense, uniform, well sodded, and reasonably weed free as judged by the Owner's Representative

3. Reset plant materials which have settled or become un-set

4. Replace plant materials which appear to be a different species or variety than specified.

5. Provide noxious weed eradication from imported Soil Material, if required and as specified herein.

6. Complete warranty work within 30 days of warranty review.

E. Contractor is not responsible for plant loss or damage to work during warranty period which is caused by unusually extreme weather, vandalism, or Owner's lack of maintenance.

PART 2 PRODUCTS

2.1 PLANTS

A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.

B. General:

1. Sizes, grades, and conditions are listed on Plant List. Quantities are shown for Contractor's convenience. Contract is responsible for providing plants drawn on drawings.

2. Cold storage stock unacceptable.

3. Free of disease, decay, injury, insects, or indication of strawberry root weevil.

4. Full foliaged when in leaf.

5. Furnish balled and burlapped (B&B) stock with solid, properly wrapped and secured, natural ball. Stock 2 inch caliper and up to be transported and handled with root ball in wire basket.

6. Furnish container stock with sufficient roots to insure healthy growth but not root bound. When plant is removed from container soil must hold together and roots must be visible but not encircling.

7. Free from Weeds or strawberry root weevil.

8. Field grown trees and shrubs must have been transplanted or root pruned at least once no more than two years prior to this Contract.

9. Container stock may be substituted for Balled and Burlapped (B&B) or Bare Root (BR) stock at any time.

10. Container or B&B stock must be substituted for BR stock if installation season prohibits use of BR stock.

C. Trees shall have:

1. Single, straight, uniformly tapering trunks which are perpendicular to the ground, unless specified as multi-stemmed or otherwise on Plant List. Trees with co-dominant, damaged, crooked, or topped leaders will be rejected.

2. Healthy and vigorous overall condition.

3. Full and even branch distribution; structural scaffold branches at least 4 inches apart where they attach to the main trunk.

4. Well developed root systems. Trees with more than 2 inches of root ball soil covering root flare will be rejected.

5. Grafts near ground level.

6. Minimum/maximum branching heights above the ground unless specified otherwise on Plant List:

a. 2 inch caliper tree: 5' - 7'
b. 1.5 inch caliper tree: 4' - 6'

7. Conifers shall also have full, even branching to ground level and intact single leader.

8. Trees shall be free of:
   a. Major structural defects including, but not limited to, branches with narrow angle of attachment (less than 40 degrees to the trunk), bark with major branch unions, and trees with co-dominant leaders.
   b. Poor pruning practices including, but not limited to, stubbed branches and topped leader.
   c. Damage to the trunk, branches, and root system including, but not limited to, bark abrasions, sun scald, and disfiguring knots.

9. Trees shall be freshly dug during the most recent favorable harvest season.

2.2 SOIL MATERIALS

A. Imported Soil at Lawns: Imported, natural, fertile, friable; free of rock, clay, subsoil, clods, plants, roots, sticks, weeds, seeds, and other deleterious material including any evidence of horsetail. Shall conform to USDA soil texture class "loam".

B. Imported Soil at Plant Beds: Imported, blended, organic soil mix composed of loam, sand, and compost.

1. Approved Products:
   a. Primary Planting Soil by Rexius Inc, Eugene, Oregon.
   b. Frugal Planting Soil by Lane Forest Products, Eugene, Oregon.

2.3 SOIL AMENDMENT MATERIALS

A. Lawn Installation Fertilizer: Uniform composition, dry, and free flowing of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions:.

1. Nitrogen: 16 percent. (source of Nitrogen to be methyl-urea based)

2. Phosphoric Acid: 16 percent.

3. Soluble Potash: 16 percent.

B. Lawn Maintenance Fertilizer: Uniform composition, dry, and free flowing of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions:.

1. Nitrogen: 25 percent. (30% Nitrogen from slow release)

2. Phosphoric Acid: 5 percent.

3. Soluble Potash: 10 percent.

C. Plant Bed Maintenance Fertilizer: Uniform composition, dry, and free flowing of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions:.

1. Nitrogen: 16 percent. (Source of Nitrogen to be methyl-urea based)
2. Phosphoric Acid: 16 percent.
3. Soluble Potash: 16 percent.

D. Planting Tablets:

1. Product: Sierra Chemical "Agriform" with 20-10-5 chemical analysis, or approved.

E. Micorrhizal Fungi:

1. MycroApply® All Purpose Granular by Micorrhizal Applications Inc, Grants Pass, Oregon (541-476-3985), or approved.

F. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.

2.4 CONCRETE PAVERS

A. 18 inch x 18 inch x 2 inch grey concrete pavers, by Willamette Graystone, or approved.

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.5 RIVER ROCK

A. Products:

1. Round river rock by Lane Forest Products, Eugene, Oregon.
2. Size: 1 1/2 inch round.
3. Substitutions: See Section 01 60 00 - Product Requirements.

2.6 **ROCK FLOW SPREADER**

A. Products:

1. Material: Cobblestone, by Lane Forest Products, or approved.
2. Size: 4 inch to 8 inch.

2.7 GRASS SEED

A. Certified Oregon Blue Tag Free of Weed seed with dealer's statement analysis guarantee.

B. Current or latest season's crop labeled in conformance with State and US Department of Agriculture laws and regulations:

1. Purity: 98% by weight
2. Germination: 90%

C. Products: Natural Knit by Ledeboer Seed LLC, 503-678-7333, Aurora, Oregon, or approved.

2.8 LAWN SOD

A. Three Way Perennial Rye Blend by Willamette Turf, Salem, Oregon, or approved.

2.9 MULCH MATERIALS

A. Mulch Material at Plant Beds: Quarter Coarse Fir Bark from Lane Forest Products, Eugene, Oregon, or approved.

B. Mulch Material at Tree Grates: Gravel

2.10 ACCESSORIES

A. Wrapping Materials: Burlap.

B. Stakes: 2 x 2 inch x 8 feet wood stakes, capable of at least 2 years ground burial, stained charcoal or black.

C. Tree Ties: Chain lock tree ties, 1 inch wide, or approved.

2.11 HERBICIDE

A. Broad Spectrum Non-Selective: Buccaneer Plus, or similar.

B. Selective for Broadleaves: Speed Zone, Weed-B-Gone, or similar.

C. Selective for Grasses: Envoy or similar.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to installation of Work of this Section, carefully inspect the work of others and verify that such work is complete to the point where this installation may properly commence.

B. Verify that materials and surfaces to receive work specified herein are accurately sized, shaped, and located; sound, secure, true, complete, and otherwise properly prepared.

C. Verify subgrades produce positive drainage and allow for placement of Soil Material, Ammendments, and Mulch to specified depths.

D. Do not install Work of this Section until all unsatisfactory conditions have been corrected. Beginning Work of this Section signifies acceptance of existing conditions.

3.2 TOLERANCES

A. Perform earthwork true to lines and grades, and to prevent ponding of water, with maximum variation in elevations of +/- 1/2 inch at subgrades and +/- 1/4 inch at finish grades.

B. Compacted thickness of materials within 1/4 inch of specified thickness.

3.3 PREPARATION OF SUBGRADE

A. Prepare subsoil to eliminate uneven areas or low spots. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds and undesirable plants and their roots, stones, rock, and dirt clods. Remove contaminated subsoil.

C. Scarify subsoil to a depth of 4 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

D. Verify subgrades, whether comprised of subgrade soil or fill drain freely. Test area by flooding with Owner's Representative present. Where water does not drain freely auger a 10 inch hole, minimum 1 per 1,000 square feet, through fill material and into subsoil, or minimum 4 feet deep into subsoil to establish positive drainage.

E. Verify subgrades allow for placement of Soil Material, Amendments, and Mulch to depths specified.

F. Notify Owner's Representative for Subgrade Preparation Review prior to placing Soil Material.

3.4 PLACING SOIL MATERIAL

A. Soil Material Placement Schedule:

1. At Plant Beds: 18 inches minimum depth.

2. At Refurbished Plant Beds: Utilize existing soil where possible to achieve required minimum planting bed depths of 18 inches.

3. At Lawn Repair Areas: Place Soil Material as required to blend grades and establish positive drainage.

4. At New Lawns: 12 inches inches minimum depth.

5. Place additional Soil Material as required to establish finish grades shown on drawings and to fill in depressions, blend grades, and produce positive drainage.

B. Place Soil Material during dry weather and on dry unfrozen subgrade. Suspend Soil Material placement if subgrade or Soil Material become saturated.

C. Phase Soil Material placement so that equipment does not travel over Soil Material already installed.

D. Place Soil Material in a relatively dry state to depths specified at locations shown on Drawings:

1. Remove stones, roots, grass, weeds, debris, and foreign material while spreading.

2. Manually spread around existing trees, paving, and other structures to prevent damage.

3. Establish levels, profiles, slopes, contours, and uniform gradients between given grade points as shown on Drawings.

4. Eliminate uneven or low spots at lawns and plant beds.

5. Fine grade Soil Material within specified tolerances.

E. Notify Owner's Representative for Soil Material Placement Review prior to proceeding with Work.

3.5 INITIAL WEED CONTROL

A. Inspect plant beds and lawns for the presence of weeds. If weeds are present apply broad spectrum herbicide.

B. During herbicide application ensure safety and environmental precautions are taken and best management practices are employed. Adjust procedures adjacent to waterways.

3.6 SOIL PREPARATION AND FINISH GRADING

A. Remove debris, sticks, roots, clods, stones, and soils contaminated by petroleum products at plant beds and lawns. Rake smooth, eliminate uneven areas or low spots in Soil Material, and set grades for positive drainage.

B. Scarify subgrade to a depth of 6 inches prior to placing Soil Material. Do not allow the subgrade to become compacted after scarifying.

C. Use stock piled topsoil in the following order of hierarchy:

1. Lawn Repair.

2. New Lawns.

3. Refurbished Plant Beds.

D. At plant beds:

1. Apply herbicide to remove weeds as described in Initial Weed Control.

2. Rake smooth and reset finish grades eliminating uneven or low spots in plant beds and setting grades for positive drainage. Ensure grades at edges of plant beds allow for placement of Mulch Material to specified depths and as detailed.

E. At trees:

1. Use Imported Soil Material for backfilling trees.

F. At lawns:

1. Apply herbicide to remove weeds as described in Initial Weed Control.

2. Spread Lawn Installation Fertilizer at the rate of 15 lbs per 1000 square feet. If a Terraseeding method is used for lawn installation do not apply Lawn Installation Fertilizer.

3. Rototill to a minimum depth of 4 inches, except within 10 feet of existing trees and Tree Protection zones.

4. Set finish grades to ensure that finish grade of lawn will be flush with surrounding surfaces.

5. Establish a friable, fine textured seed bed free of bumps and depressions immediately before seeding.

6. Firm seed bed with a lawn roller making passes in 2 directions.

G. At lawn repair areas:

1. Apply herbicide to remove weeds as described in Initial Weed Control.

2. Place additional Soil Material as necessary to fill in depressions and blend grades with surrounding lawns, plant beds, and paving.

3. Set finish grades to ensure that finish grade of lawn will be flush with surrounding surfaces.

4. Establish a friable, fine textured seed bed free of bumps and depressions immediately before seeding.

5. Firm seed bed with a lawn roller making passes in 2 directions.

6. Spread Lawn Installation Fertilizer at the rate of 15 lbs per 1000 square feet. If a Terraseeding method is used for lawn installation do not apply Lawn Installation Fertilizer.

H. Notify Owner's Representative for Finish Grading Review prior to proceeding with Work.

3.7 SECOND WEED CONTROL

A. After completion of Soil Preparation and finish grading commence irrigation of all plant beds, lawns, and erosion control grass areas. If weeds are present apply broad spectrum herbicide.

B. Wait ten days minimum and inspect all plant beds and lawn areas for the presence of any additional weeds. If weeds are present, apply a second application of Herbicide to affected areas and delay planting until all weeds are dead.

C. During herbicide application ensure safety and environmental precautions are taken and best management practices are employed. Adjust procedures adjacent to waterways.

3.8 INSTALLATION OF PLANT MATERIAL

A. Plant Material Review: Notify Owner's Representative prior to the delivery of all trees and plant materials to the site but prior to installing plants. Owner's Representative will review quality of plant materials and reject plant materials not in compliance the the Plant List and Specifications. This review is preliminary. Final approval of plants materials will not be given until Completion Review.

B. Plant Material Layout Review: Layout plant material (in containers or B&B) at plantbeds for review prior to installation. Notify Owner's Representative for review of plant material layout prior to commencement of planting. The plant material layout review may occur concurrently with the planting mock-up review. Adjust plant materials as directed.

C. Planting Mock-Up Review: Notify Owner's Representative prior to commencement of planting. Install an initial 500 square feet sample of typical plantings for review. Adjust planting procedure as directed.

D. Tree Planting:

1. Soak container grown, B&B, and BR plants before planting.

2. Remove extra soil on top of root ball to expose flare of first buttress root. Root flare must be visible at top of root ball.

3. Dig individual planting holes circular with vertical sides as shown on Planting Detail.

4. Save and thoroughly loosen soil removed from planting hole and use as backfill around tree. Backfill trees with specified mixture if additional Soil Material is needed.

5. Sprinkle micorrhizal fungi to surface of planting holes at rate of 2-4 ounces per inch of stem caliper.

6. Install Planting Tablet at trees at manufacturer's recommended high rate.

7. Lift trees by wire basket only. Do not lift trees by trunk or use trunk as a lever to position or move tree.

8. Set B&B trees in the hole with the north marker facing north unless otherwise approved.

9. Set root crown as shown on Planting Detail not less than 3 inches above surrounding finish grade.

10. Cut and completely remove twine and other fasteners from root ball. Remove burlap from top half of root ball. Remove all burlap if not biodegradable. Neatly cut off broken or frayed roots.

11. Remove top half of wire basket after planting.

12. Stake trees as shown on Planting Detail.

E. All other Plants:

1. Soak container grown, B&B, and BR plants before planting.

2. Dig individual planting holes with circular and with vertical sides 1-1/2 inch shallower than depth of root ball.

3. Dig holes for pocket-planted shrubs 3 times the diameter of the rootball.

4. Sprinkle micorrhizal fungi to surface of planting holes at the following rates:
   a. #SP4 container - 1 tablespoon
   b. #1 container - 2 tablespoons
   c. #3 container - 3 tablespoons
   d. #5 container - 5 tablespoons

5. Install Planting Tablet at shrubs and ground covers at manufacturer's recommended high rate.

6. Cut circling roots with a sharp knife.

7. Set root crowns 1-1/2 inch above surrounding grade and as detailed.

F. Plants set too deeply will be rejected. Reset plants that have settled.

G. Set Plants plumb and for best appearance.

H. Carefully tamp soil under and around root balls and bare roots to prevent settlement.

I. Backfill pocket-planted plants with Soil Material.

J. Flood hole when half backfilled and tamp soil between bare roots.

K. Complete backfilling and tamp soil between bare roots.

L. Thoroughly water each plant and entire bed immediately after planting.

M. Remove all tags, labels, strings, etc. from plants.

N. Prune Plant Material to remove dead, broken, or damaged branches.

O. Rake plant beds smooth, resetting finish grades for positive drainage and eliminating uneven or low spots.

3.9 MULCH INSTALLATION

A. Install 3 inch minimum depth Mulch within 24 hours after planting at plant beds and trees as shown on drawings and details.

B. Remove excess Mulch from foliage of plant materials and from bark of trees. Mulch must not be placed within 3 inches of tree trunks. Remove mulch from adjacent surfaces and produce edges shown on Details.

3.10 LAWN INSTALLATION

A. Install lawns using one of the following methods, except do not use sod at reinforced paving areas and Terraseeding is required at Renovated Lawns in no rototilling zones.

1. Hydroseeding:
   a. Mix components are the following rates and apply uniformly and completely:
      1) Seed: 8 lbs per 1000 square feet
      2) Lawn Installation Fertilizer: 15 lbs per 1000 square feet
      3) Sufficient hydromulch to keep areas moist during germination and protect seed from wind erosion.
   b. Ensure all equipment, including hoses, is clean and contains only the specified seed.

2. Sod:
   a. Apply Lawn Installation Fertilizer at a rate of 15 lbs per 1000 square feet.
   b. Dampen soil sufficiently to prevent moisture from being drawn out of sod.

c. Protect sod from effects of severe weather conditions. Install sod within 48 hours of delivery.
d. Lay on prepared grade butting edges tightly together.
e. Stagger joints on adjacent courses so that end joints are at least 6 inches apart.
f. Press sod to prepared base by rolling with a 100 lb (minimum) roller.
g. Aerate new sod 6 weeks after installation.

B. Apply water with fine spray immediately after each area is sown.

C. Provide a temporary barrier at the limits of newly planted lawns.

3.11 MAINTENANCE

A. At Plant Beds during period between installation and Final Completion:

1. Water, fertilize, weed, reset unstable or disturbed plants, and perform other maintenance necessary to assure healthy growth.

2. Install Plant Bed Maintenance Fertilizer at a rate of 6 lbs per 1000 square feet 45-60 days after installation. Adjust timing for seasonal requirements of plant materials.

3. Thoroughly water immediately after applying Plant Bed Maintenance Fertilizer.

4. Repair and regrade erosion damage .

5. Provide continued weed control and removal until any weed problem is fully eradicated.

B. At lawns during period between installation and Final Completion:

1. Water, weed, mow, reseed, top dress, and fertilize as necessary to establish a healthy, dense, uniform, weed free stand of grass; maintain at 2 inches high. This includes unirrigated lawns, unless otherwise noted on drawings.

2. Conduct first mowing after grass is firmly rooted and secure. Mow grass when it exceeds 2 inches in height, cutting no more than 1/3 of the grass height at a time. Remove all clippings.

3. Maintain surfaces and supply additional Soil Material and Seed where necessary.

4. After first mowing apply Lawn Maintenance Fertilizer at a rate of 8 lbs per 1000 square feet. Thoroughly water after application.

5. Apply Herbicide (selective) to remove weeds.

3.12 CLEANING

A. Remove excess materials from site. Protect drain inlets and underground piping as necessary and clean improvements soiled by Work of this Section.

3.13 COMPLETION REVIEW

A. Notify Owner's Representative for Completion Review when Work of this Section is complete.

END OF SECTION

WATER UTILITIES

PART 1 GENERAL

1.1 CONTRACT CONDITIONS

A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.2 SECTION INCLUDES

A. Private on-site water distribution system improvements, including domestic and fire protection systems.

1.3 WORK INCLUDED BUT SPECIFIED IN OTHER SECTIONS

A. Section 31 23 33 - Trenching and Backfill

1.4 REFERENCED SPECIFICATIONS

A. ASTM Standards (current edition)

B. AWWA Standards (current edition)

C. NFPA Standards (current edition)

1.5 SUBMITTALS

A. Comply with Section 01 33 00, unless otherwise indicated.

B. Product Data: Manufacturer's specifications and technical data including performance, construction, and fabrication information.

1. Submit for: FDC; backflow preventer, vault and sump pump.

2. Submit buoyancy calculations for backflow preventer vault. Use a factor of safety of 1.5 and assume groundwater level at 0 ft below finished grade per Geotechnical Report, relative to potential for seasonal perched groundwater.

3. Contractor shall provide the Architect with 6 sets of shop drawings complying with Eugene Fire Department private water system review checklist. After Architect’s review, submit three copies of shop drawings to Fire Department for review and approval. Shop drawings shall incorporate all information required by the private water system review checklist including, but not limited to, the following: pipe sizes, materials, locations, depth of bury; fire department connection types and locations; indicate pipe restraint type (thrust blocking or mechanical joint restraint), size, and locations.

C. Field Quality Control submittals as specified in Part 3 of this Section:

1. Field Tests

2. Special Inspections for Code Compliance

D. Closeout Requirements: Comply with Section 01 77 00.

1. Provide record documents.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

B. Installer's Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Deliver products in original, unopened packaging with legible manufacturer's identification.

B. Storage and Protection: Comply with manufacturer's recommendations.

1. Protect from damage by the elements and construction procedures.

1.8 ADVANCE NOTICES

A. Notify Engineer at least 48 hours before starting work of this section.

1.9 COORDINATION

A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.1 FIRE PROTECTION WATER PIPE AND FITTINGS (4 INCH AND LARGER) (UNLESS OTHERWISE NOTED)

A. Polyvinyl Chloride Plastic Pipe:

1. Pipe: PVC, AWWA C900 (4" to 12"), .AWWA C905 (14" to 16"), DR 18.

2. Fittings: Gray or Ductile iron, mechanical joint, conforming to AWWA C110 or AWWA C153, with exterior asphaltic seal coat and cement mortar lining per AWWA C104 or Fusion Bonded Epoxy in accordance with AWWA C116.

3. Joints:

a. Unless otherwise specified: Gasket, push-on joints unless otherwise specified, conforming to ASTM D3139.

b. Mechanical Joints: AWWA C110, with gasket joints per AWWA C111 and corrosion resistant bolts.

B. Restrained Joints: Provide as indicated on the drawings according to the following:

1. Mechanical Joints: UL and FM approved, ductile iron mechanical joint follower gland with restraining wedges secured to pipe by torque limiting twist-off nuts, EBBA Iron Sales "Mega Lug" Series 2000 PV or Romac "Romagrip".

2. Push-On Joints: Clamp ring and fire-bolt assembly with ductile iron ring and corrosion resistant bolts. Uni-Flange Series 1350.

2.2 FIRE PROTECTION WATER PIPE AND FITTINGS (4 INCH AND LARGER, BUILDING APPROVED MATERIAL)

A. Ductile Iron Pipe:

1. Pipe: 60-42-10 Ductile Iron meeting the requirements of AWWA C151, with standard exterior asphaltic seal coat and cement mortar lining per AWWA A21.4, minimum Pressure Class 150 or as specified on project plans.

2. Fittings: Gray or Ductile iron, mechanical joint, conforming to AWWA C110 or AWWA C153, with exterior asphaltic seal coat and cement mortar lining per AWWA C104 or Fusion Bonded Epoxy in accordance with AWWA C116.

3. Joints:

a. Unless Otherwise Specified: Gasketed, push-on joints unless otherwise specified, conforming to AWWA C111.

b. Mechanical Joints: AWWA C110, with gasket joints per AWWA C111 and corrosion resistant bolts.

c. Flanged Joints: AWWA C115, with gasket joints per AWWA C111 and corrosion resistant bolts.

B. Restrained Joints: Provide as indicated on the drawings according to the following:

1. Mechanical Joints: UL and FM approved, ductile iron mechanical joint follower gland with restraining wedges secured to pipe by torque limiting twist-off nuts, EBBA Iron Sales "Mega Lug" Series 2000 PV or Romac "Romagrip".

2. Push-On Joints: Clamp ring and fire-bolt assembly with ductile iron ring and corrosion resistant bolts. Uni-Flange Series 1350.

C. Polyethylene Encasement: Provide 8-mil polyethylene encasement for all buried piping in accordance with AWWA C105, and in accordance with pipe manufacturer's recommendations.

D. Bolts: Mechanical Joint bolts shall be corrosion resistant, high-strength low alloy steel conforming to the requirements of AWWA A21.11

E. Installation shall be in accordance with AWWA C600 and manufacturers recommendations.

2.3 DOMESTIC WATER PIPE AND FITTINGS (3 INCH AND SMALLER) (UNLESS OTHERWISE NOTED)

A. Either of the following options for pipe material options may be used:

1. Option #1 (Engineer preferred option):

a. Pipe: Type L copper, hard drawn, conform to ASTM B88.

b. Fittings: Grooved-end, wrought copper, conform to ANSI B16.22.

c. Joints: Roll-grooved CTS with rigid couplings.

2. Option #2:

a. Pipe: PVC, SDR 21, ASTM D2241.

b. Fittings: PVC, ASTM D2466.

c. Joints: Bell and spigot with rubber gaskets, conform to ASTM F3139 and ASTM F477.

3. Option #3:

a. Pipe: PVC Schedule 40, ASTM D1784.

b. Fittings: PVC, ASTM D1784 and D2466.

c. Joints: Solvent-cemented, in accordance with ASTM D2564.

2.4 DOMESTIC WATER PIPE AND FITTINGS (3 INCH AND SMALLER, BUILDING APPROVED MATERIAL)

A. Shall be Schedule 40 CPVC, ASTM D1784 (latest revision), Type 1 NSF, approved for potable water with solvent cement joints.

2.5 GATE VALVES FOR DOMESTIC AND FIRE PROTECTION SYSTEMS

A. Shall be iron body, class 125, flexible wedge disc, non-rising stem, stuffing box repackable under pressure, UL listed and FM approved (fire protection system only), rated working pressure of 150 psi minimum and conforming to AWWA C515-01. Crane, Kennedy, or Grinnell. Similar to Kennedy Model 7561 or Kennedy Model 7572.

2.6 VALVE BOXES

A. Cast iron conforming to ASTM A48 (latest revision), rated for H20 traffic loading, with a rust protective coating; cover marking "water"; bury depth as required on drawings. Olympic Foundry, Inc. VB910.

2.7 FIRE DEPARTMENT CONNECTION

A. Shall be double clapper, 2-way, 90 degree Siamese inlet; rough brass; two 2-1/2 inch inlets, one 4 inch outlet; brass caps with chains, National Standard Threads threads conforming to local fire department; UL listed, FM approved, and conforming to City standards. Designated "AUTO SPRINKLER." Contractor to verify manufacturer with Fire Marshal.

2.8 BACKFLOW PREVENTER

A. Domestic Water System:

1. Double check backflow preventer, 2 inch, maximum working pressure of 175 psi, with OS&Y valves, UL listed. Febco, Conbraco or approved by both EWEB and University.

2.9 BACKFLOW PREVENTER VAULT (BELOW GRADE)

A. *Note that this section requires further review by CAPITAL and review by the University.*

B. Vault:

1. Vault: Precast reinforced concrete vault per ASTM C-875, rated for H20 traffic loading, size appropriate to selected backflow preventer and conforming with details, joints and openings grouted watertight, Utility Vault, Hanson, or approved.

2. Ladder: Provide galvanized ladder meeting OSHA requirements and capable of extending 42 inches above top of vault. Ladder to be permanently mounted when vault depth exceeds 4 feet.

3. Access Hatch: Galvanized hinged access hatch, 3' ± by 6' ± minimum opening size, traffic rated for H20 loading, locking latches, spring assisted doors. Access hatch shall factory-applied non-skid coating on all metal surfaces exposed to traffic.

C. Permanent Dewatering System:

1. Sump Pump:

a. Type: Submersible.

b. Motor: Oil filled, built-in auto reset overloads.

c. Bearings: Permanently lubricated.

d. Impeller: Bronze no-clog.

e. Seal: Mechanical

f. Controls: Built-in, internal control system. Set "on" level at 7 to 10 inches above sump floor and one high water alarm float.

g. Cord: 3-wire with 3-prong grounded plug, 10-foot long.

h. Power / Power Supply: 1/3 HP, 120 volt, 1-phase.

i. Capacity: 20 gpm at 22 ft total head

j. Manufacturer: Hydromatic, Paco, Little Giant, or approved.

k. Refer to Electrical for power, receptacle, and connections.

2. Discharge Piping:

a. Routing: Route piping from sump pump discharge through vault, holding tight to sides of vault. Extend piping through vault side through a weep hole to be drilled through the nearest curb on site as detailed on drawings.

b. Pipe: 2" diameter PVC Schedule 40 per ASTM D1784 with solvent cement joints.

c. Check Valve / Union: Thermoplastic industrial ball check type manufactured per ASTM F 1970, Spears True Union 2000 or approved. Locate valve 12-18 inches above pump discharge elevation or as recommended by pump manufacturer.

D. Temporary Dewatering System:

1. Provide temporary dewatering of vault until permanent dewatering system is installed.

E. Vault High Water Alarm:

1. Float Switch: Corrosion resistant, high impact float switch with normally closed contacts, SJE Signal Master or approved. Set float switch at 18 inches above vault floor. Provide waterproof junction box mounted within vault and provide additional float switch wiring as needed to reach inside building.

2. Alarm Configuration: The configuration, supervision and reporting of the vault high water alarm shall be approved by the UO Fire Marshal.

3. Wiring and Connections: Electrical contractor to provide power and connections. All electrical work shall comply with Division 26 and shall be performed by a licensed Electrician.

4. Signs: Provide engraved plastic signs. Location and text of sign as follows:

a. Backflow Preventer Vault: Mount sign on inside of vault wall above float switch at a location visible from the access hatch. Sign text:

b. HIGH WATER ALARM – PUMP FAILURE

2.10 BALL DRIP

A. Ball drip shall have brass body, inlet and outlet threads, and have automatic operation.

2.11 MECHANICAL JOINT RESTRAINT RESTRAINED JOINTS

A. Mechanical Joints: At MJ Fittings: Ductile iron mechanical joint follower gland with restraining wedges secured to pipe by torque-limiting twist-off nuts. EBBA iron sales "Mega Lug" Series 2000 PV or Romac “Romagrip”. At Push-on Joints: Clamp-ring and fire-bolt assembly with ductile iron ring and corrosion resistant bolts. Uni-flange series 1350.

2.12 CONCRETE

A. Concrete shall be ready-mixed conforming to Section 03 30 00, CAST-IN-PLACE CONCRETE, and shall have a compressive strength of 3,000 psi at 28 days. Maximum size of aggregate shall be 1½ inches.

2.13 OTHER MATERIALS

A. Recommended by Manufacturer and subject to Engineer's review and acceptance. Provide all materials required to complete and make water system operational.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

A. Prior to installation, carefully inspect trench, excavations and base to verify that all such work is complete to the point where this installation may properly commence.

B. Do not install work of this Section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.

C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.2 TRENCHING AND BACKFILL

A. Trenching and backfill shall conform to the requirements of Section 31 23 33, TRENCHING AND BACKFILL.

3.3 PIPE INSTALLATION

A. Installation shall be in accordance with the manufacturer's recommendations. All pipe ends and interiors shall be thoroughly cleaned of all foreign matter and shall be kept clean during installation. When work is not in progress, all open ends of pipe and fittings shall be securely closed so that no trench water, earth, animal life or other substance may enter.

B. Cutting of pipe to be done in a neat and workmanlike manner by method which will not damage pipe and as recommended by manufacturer.

C. Install piping within 0.02 feet of indicated grade and location.

D. All ductile iron pipe joints and fittings shall be fully covered with asphaltic coating.

3.4 THRUST BLOCKS AND MECHANICAL JOINT RESTRAINT

A. Install thrust blocks or mechanical joint restraint at all changes of directions and fittings, as required and as appropriate.

3.5 VALVES, FITTINGS AND CAPS

A. Shall be set and joined to the pipe as shown on the drawings. All pipe shall be supported to prevent stress on valves. All dead ends shall be closed with plugs or caps that are suitably restrained to prevent blowing off under test pressure.

3.6 VALVE BOXES

A. Shall be provided for every valve. Box shall be centered along axis of the operating nut of the valve and shall be set so as not to transmit shock or stress to the valve or valve operator. Keep box free of debris.

B. Set rim flush with adjacent finished surfaces unless otherwise noted.

3.7 FIRE DEPARTMENT CONNECTION

A. Conform to referenced specifications AWWA Manual M17 and AWWA C600. Location and signage of the FDC shall be approved by the UO Fire Marshal.

B. Set fire department connection plumb and square with adjacent construction.

3.8 BACKFLOW PREVENTER AND VAULT

A. Install on compacted gravel base, level, plumb, square with adjacent construction, with rim flush with adjacent surfaces in accordance with manufacturers recommendations. Provide with tamper switch. Comply with EWEB and Owner installation requirements.

B. EWEB to provide and install detector meter on backflow preventer and remote reader in vault. Coordinate vault requirements with EWEB. Coordinate work and schedule with EWEB.

C. Construct drain line from vault through nearest adjacent curb as a weephole as indicated on drawings. Locate drain so that drain extends level from vault to daylight.

D. Manufactured pipe supports to be installed and adjusted appropriately to support backflow preventer at the required elevations.

3.9 CONNECTION TO EXISTING FIRE PROTECTION WATER MAIN

A. *Note that this section requires further review by CAPITAL.*

B. Prepare shut-down plan and submit to Architect and Owner for approval.

C. Water mains that are to be cut into for new connections shall be repaired per Oregon DHS Drinking Water Program requirements.

D. Connections to existing mains shall be not result in shut down of water service to existing facilities for more than 6 hours *(needs Owner review)*. Schedule additional crews as needed to complete work within necessary time frame. Conduct work during non-peak hours as directed by Owner.

E. Preparation for Repair:

1. Turn valve down to reduce mainline flow but maintain positive pressure.

2. Excavate below the main creating a sump and dewater.

3. Isolate mainline by shutting other services off providing advance notice to all users as required. Notify Owner 48 hours prior to starting work.

F. Repair process:

1. Treat exterior of exposed pipe with hypochlorite solution (account for control of residual chlorine in discharge water).

2. Disinfect all repair items, piping and appurtenances per AWWA C651 Standard.

3. Conduct the repair with disinfected parts and ensure sump dewatering system is operational.

G. Cut-in process:

1. Initiate the cut in procedure by removing existing pipe and dewatering the remaining pipe.

2. Treat exterior of exposed pipe with hypochlorite solution (account for control of residual chlorine in discharge water).

3. Disinfect all repair items, piping and appurtenances per AWWA C651 Standard. Complete the cut in procedure with disinfected parts.

H. Finalizing connection construction:

1. Repressurize the main by opening mainline valve and check for leaks.

2. Flush the line through a fire hydrant or blowoff.

3. Flush in a direction to best clear the main of any debris/sediment and until air is gone and water flows clear.

4. For water systems that apply and maintain a chlorine residual, check the chlorine residual at a point downstream of the main break. Residual should be consistent (not lower) with surrounding area.

5. Collect a coliform bacteria sample per AWWA C651 Standard to provide a record of repair procedure effectiveness. Mark as a "special sample" and retain in records for 2 years.

6. Restore all valves to their normal operating positions.

7. Open user services and operate the outdoor hose bib to remove air and turbid water. If no outside bib is accessible, coordinate building access with Owner.

8. If the post-construction coliform sample result shows the presence of coliforms, resample per coliform sampling procedures. If second sample results show presence of coliforms, contact the Engineer to consult on corrective action.

3.10 WORK BY UTILITY COMPANY

A. Initiate service, coordinate, and schedule water service, connection, meter installation, remote reader by EWEB.

3.11 FIELD QUALITY CONTROL

A. Refer to Section 01 45 00 for responsibilities for arranging, supervising, and payment of field quality control requirements.

B. Field Tests:

1. Hydrostatic tests as described below.

2. Disinfection Tests.

C. Field Inspections: Notify Engineer prior to work of this section.

D. Special Inspections for Code Compliance:

1. Test hydrostatically. All testing, acceptance, and documentation shall comply with Oregon State Plumbing Specialty Code (current edition) and NFPA and AWWA specifications as applicable.

2. Prior to testing partially backfill or provide other means of restraint to prevent any movement during the test.

3. Observance: Plumbing inspector to observe domestic, mainline irrigation, and fire line testing. Fire Department to observe fire line testing. Contractor shall notify plumbing inspector and Fire Department at least 48 hours prior to testing.

4. Obtain plumbing inspector and fire marshal approvals and submit to Engineer.

3.12 FLUSHING AND DISINFECTION

A. Flushing:

1. Contractor shall flush and clean all parts of all completed system. All pipe and structures shall be clean and free of all construction debris, rocks, gravel, mud, sand, silt, and other foreign material, and as directed by the Engineer.

B. Disinfection:

1. Disinfect all domestic water supply piping and appurtenances in accordance with AWWA C651 and Oregon State Health Department requirements.

2. Provide written certification from a firm specializing in disinfection that the disinfection has been successfully completed.

3. Dispose of test water in accordance with all governing rules and regulations.

3.13 CLEANING

A. Upon completion of the work of this section promptly remove from the working area all scraps, debris and surplus material.

3.14 PROTECTION

A. Protect all Work installed under this section.

B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

SANITARY SEWERAGE UTILITIES

PART 1 GENERAL

1.1 CONTRACT CONDITIONS

A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.2 SECTION INCLUDES

A. On-site private sanitary sewer system improvements.

1.3 WORK INCLUDED BUT SPECIFIED IN OTHER SECTIONS

A. Section 31 23 33 - Trenching and Backfill

1.4 SUBMITTALS

A. Comply with Section 01 33 00, unless otherwise indicated.

B. Field Quality Control submittals as specified in Part 3 of this Section:

1. Field Tests

2. Special Inspections for Code Compliance

C. Closeout Requirements: Comply with Section 01 77 00.

1. Provide record documents.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

B. Installer's Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Deliver products in original, unopened packaging with legible manufacturer's identification.

B. Storage and Protection: Comply with manufacturer's recommendations.

1. Protect from damage by the elements and construction procedures.

1.7 ADVANCE NOTICE

A. Notify Engineer at least 48 hours before starting work of this section.

1.8 COORDINATION

A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPE AND FITTINGS (6 INCH AND SMALLER)

A. Shall be Schedule 40 ABS (DWV), ASTM D2661 (latest revision), with solvent cement joints.

B. Provide with manufactured fittings unless otherwise noted on drawings.

2.2 CONCRETE

A. Concrete shall be ready-mixed conforming to Section 03 30 00, CAST-IN-PLACE CONCRETE, and shall have a compressive strength of 3,000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

2.3 OTHER MATERIALS

A. Recommended by Manufacturer and subject to Engineer's review and acceptance. Provide all materials required to complete and make drainage system operational.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

A. Prior to starting work of this section, carefully inspect trench, excavations, and pipe bedding to verify that all such work is complete to the point where this installation may properly commence.

B. Do not install work of this section until unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.

C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.2 TRENCHING AND BACKFILL

A. Trenching and backfill shall conform to the requirements of Section 31 23 33, TRENCHING AND BACKFILL.

3.3 PIPE INSTALLATION

A. Installation shall be in accordance with the manufacturer's recommendation. All pipe ends and interiors shall be thoroughly cleaned of all foreign matter and shall be kept clean during installation. When work is not in progress, all open ends of pipe and fittings shall be securely closed so that no water, earth, animal life, or other substance may enter.

B. Cutting pipe shall be done in a neat and workmanlike manner by method which will not damage pipe and as recommended by manufacturer.

C. Install piping within 0.02 foot of indicated grade and location.

D. Trim pipe ends flush with manhole interior walls.

E. All ductile iron pipe joints and fitting joints within 5 feet of building and beneath building shall be fully covered with asphaltic coating. Wrap ductile iron pipe and fittings within 5 feet of building and beneath building with polywrap.

3.4 FIELD QUALITY CONTROL

A. Refer to Section 01 45 00 for responsibilities for arranging, supervising, and payment of field quality control requirements.

B. Field Inspections: Notify Engineer prior to work of this section.

C. Special Inspections for Code Compliance:

1. Provide hydrostatic test or air test per State of Oregon Plumbing Specialty Code.

2. Obtain plumbing inspector approvals and submit to Engineer.

3.5 CLEANING

A. Prior to final acceptance, Contractor shall flush and clean all elements of the completed system. All pipe and structures shall be clean and free of all construction debris, rocks, gravel, mud, sand, silt, and other foreign material, and as directed by the Engineer.

B. Upon completion of work of this section promptly remove from the working area all scraps, debris, and surplus material.

3.6 PROTECTION

A. Protect all work installed under this section.

B. Replace at no additional cost to Owner, any damaged work of this section.

END OF SECTION

STORM DRAINAGE UTILITIES

PART 1 GENERAL

1.1 CONTRACT CONDITIONS

A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.2 SECTION INCLUDES

A. On-site private storm drain system improvements.

1.3 RELATED SECTIONS

A. Section 31 23 33 - Trenching and Backfill

B. Section 33 49 13 - Storm Drainage Manholes, Frames and Covers

1.4 SUBMITTALS

A. Comply with Section 01 33 00, unless otherwise indicated.

B. Product Data: Manufacturer's specifications and technical data including performance, construction, fabrication, and installation information.

1. Submit for: Inlets and grates, cleanout covers.

C. Field Quality Control submittals as specified in Part 3 of this Section:

1. Field Tests

2. Special Inspections for Code Compliance

D. Closeout Requirements: Comply with Section 01 77 00.

1. Provide record documents.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

B. Installer's Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Deliver products in original, unopened packing with legible manufacturer's identification.

B. Storage and Protection: Comply with manufacturer's recommendations.

1. Protect from damage by the elements and construction procedures.

1.7 ADVANCE NOTICES

A. Notify Engineer at least 48 hours before starting work of this section.

1.8 COORDINATION

A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.1 STORM DRAIN PIPE AND FITTINGS (UNLESS OTHERWISE NOTED)

A. Either of the following pipe materials may be used.

1. PVC Solid Wall: Shall be Polyvinyl chloride plastic pipe with rubber gasket joints. Manufacturing Standard: ASTM D3034 (latest revision) SDR 35 for pipe sizes 4"-15" and ASTM F679 (latest revision) for pipe sizes 18"-24", T-1 wall thickness. Provide with manufactured fittings unless otherwise noted on drawings.

2.2 STORM DRAIN PIPE AND FITTINGS (DUCTILE IRON) (BUILDING APPROVED MATERIAL, FOR USE UNDER AND WITHIN 2 FEET OF BUILDING)

A. Shall be cement-lined ductile iron pipe, Class 52, conforming to AWWA C151. Fittings shall be Class 52, conforming to AWWA C153 for mechanical joints pressure rating of 350 psi and AWWA C110 for flange joints pressure rating of 250 psi. Provide with manufactured fittings unless otherwise noted on drawings.

B. Provide pipe wrap, 8 mil polywrap meeting pipe manufacturer's recommendations.

2.3 STORM DRAIN PIPE AND FITTINGS (BUILDING APPROVED MATERIAL, FOR USE UNDER AND WITHIN 2 FEET OF BUILDING)

1. PVC DWV, ASTM D2665 (latest revision).

2. ABS Schedule 40/DWV, ASTM D2661 (latest revision).

3. PVC Schedule 40/DWV Cellular Core Pipe, ASTM F891 (latest revision).

4. PVC Schedule 40, ASTM D1785 (latest revision).

B. Provide with manufactured fittings unless otherwise noted on drawings.

2.4 PERFORATED PIPE AND FITTINGS

A. Shall be smooth interior perforated corrugated polyethylene pipe with AASHTO Type 'S' designation meeting the requirements of AASHTO M252 (pipe sizes 4" – 10") and AASHTO M294 (pipe sizes 12" – 60"). Provide with manufactured fittings unless otherwise noted on drawings.

B. Provide with machine-knitted polyester drain envelope, 100-135 burst strength. Equivalent opening size of 30 to 40.

2.5 PERFORATED PIPE AND FITTINGS (SCHEDULE 40, FOR USE UNDER AND WITHIN 2 FEET OF BUILDINGS)

A. Any of the following pipe materials may be used (with solvent cement joints).

1. PVC DWV, ASTM D2665 (latest revision).

2. ABS Schedule 40/DWV, ASTM D2661 (latest revision).

3. PVC Schedule 40/DWV Cellular Core Pipe, ASTM F891 (latest revision).

4. PVC Schedule 40, ASTM D1785 (latest revision).

B. Provide with manufactured fittings unless otherwise noted on drawings.

C. Pipe perforations to be in accordance with ASTM D3034 (latest revision) perforation requirements. Post-manufacturing perforations are acceptable.

D. Provide with machine-knitted polyester drain envelope, 100-135 burst strength. Equivalent opening size of 30 to 40.

2.6 SINGLE CHAMBER CATCH BASINS

A. Shall be prefabricated steel, 12 inches square by 36 (minimum) inches deep, 10 gauge minimum, asphalt paint inside and out, 6 inch minimum water seal with hinged lid on trap, outlet size as specified on drawings. Cast iron or steel, ADA-compliant and heel-proof grate. Lynch or Gibson.

B. Use any of the following pipe materials from the catch basin to lateral where cover is less than one foot as detailed on drawings: Ductile Iron pipe and fittings (cement-lined), Class 52, AWWA C151; PVC, AWWA C900, CL150; Schedule 40 PVC, ASTM D2665, F891, or D1785 (latest revision).

2.7 AREA DRAINS

A. Shall be prefabricated steel, 8 inches diameter by 24 (minimum) inches deep, 10 gauge minimum, asphalt paint inside and out, 6 inch minimum water seal with hinged lid on trap, outlet size as specified on drawings. Cast iron or steel, ADA-compliant and heel-proof grate. Lynch or Gibson.

2.8 DECK DRAINS

A. Shall be fabricated steel body and cast iron grate with galvanized sub-coat, Duco finish inside and outside and stainless steel ported bucket with mesh screen and lift bar. ADA-compliant and heel-proof grate. Side outlet, size per drawings. JR Smith 2245.

2.9 FLEX-TRANSITION COUPLER

A. Shall be Fernco, 1000 series. Use fittings manufactured for the specific pipe size and material types being connected.

2.10 CLEANOUTS

A. Shall be constructed from solid wall pipe and fittings specified above with traffic grade frame and cover. Frame and cover shall be H20 rated cast iron valve box with flange top as detailed on drawings with "storm" marking. Varicast VB910 Rich Valve Box.

2.11 TRENCH DRAIN

A. Shall be precast polymer concrete pre-sloped channel sections with interlocking joints and horizontal ribs to ensure a positive anchor in the encasement concrete. Provide with end caps as necessary and properly fitting outlets. Provide bottom outlet.

B. Polycast: Provide Polycast Sections 601 and larger, iron frame and slotted grate assembly, load class D.

C. Polydrain: Provide Polydrain Sections 010 and larger, iron frame and slotted grate assembly, load class D.

D. Other manufacturers will be considered with approved submittal.

2.12 RIGID TRANSITION COUPLINGS

A. Ductile iron to PVC pipe connections to be "501-H" coupling by Romac Industries, Inc.

2.13 IN-LINE BACKWATER VALVE

A. In-line valve, Duco cast iron body with bronze backwater valve. Jay R. Smith 7022S series with extension to finished grade, or approved.

B. Backwater valve box shall be as follows:

1. In pavement areas – one piece concrete box, minimum 12” by 20”, with concrete cover and cast iron lid, traffic rated. Concrete box extensions as required to set cover and lid flush with adjacent, finished surface. Brooks #37 Meter Box.

2. In landscaped areas – one piece, injection molded box, minimum 12” by 20” box cover with 1/4" minimum wall thickness, with coloring and UV stabilizers added. Solid plastic cover. Plastic box extensions as required to set cover flush with adjacent, finished surface. NDS Series Meter Box.

2.14 FLAP GATE

A. Flap gate to be cast iron construction, automatic operation. Cast iron frame and cover, galvanized steel angle links, bronze bushings, and steel bolts. 5 degree seat. Waterman model F-10.

2.15 WATER SEAL GASKET

A. Shall be manufactured PVC to concrete adaptor, Romac LCT or Fernco CMA. Field fabricated water stops or improvised adapter not allowed.

2.16 CONCRETE

A. Concrete shall be ready-mixed conforming to Section 03 30 00, CAST-IN-PLACE CONCRETE, and shall have a compressive strength of 3,000 psi at 28 days. Maximum size of aggregate shall be 1½ inches.

2.17 OTHER MATERIALS

A. Recommended by Manufacturer and subject to Engineer's review and acceptance. Provide all materials required to complete and make drainage system operational.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

A. Prior to starting work of this section, carefully inspect trench, excavations, and pipe bedding to verify that all such work is complete to the point where this installation may properly commence.

B. Do not install work of this section until unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.

C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.2 TRENCHING AND BACKFILL

A. Trenching and backfill shall conform to the requirements of Section 31 23 33, TRENCHING AND BACKFILL.

3.3 PIPE INSTALLATION

A. Installation shall be in accordance with the manufacturer's recommendation. All pipe ends and interiors shall be thoroughly cleaned of all foreign matter and shall be kept clean during installation. When work is not in progress, all open ends of pipe and fittings shall be securely closed so that no water, earth, animal life, or other substance may enter.

B. Cutting pipe shall be done in a neat and workmanlike manner by method which will not damage pipe and as recommended by manufacturer.

C. Install piping within 0.02 foot of indicated grade and location.

D. Trim pipe ends flush with manhole and catch basin interior walls.

E. All ductile iron pipe joints and fitting joints within 5 feet of building and beneath building shall be fully covered with asphaltic coating. Wrap ductile iron pipe and fittings within 5 feet of building and beneath building with Polywrap.

3.4 CATCH BASINS, AREA DRAINS AND DECK DRAINS

A. Construct on compacted 4" minimum depth, 3/4" - 0 crushed rock base level, plumb, and square with adjacent construction. Set rim flush with adjacent finished surfaces unless otherwise noted.

3.5 WATER SEAL GASKET

A. To be installed in accordance with manufacturer's recommendations. Adapters requiring the use of grout for installation shall be anchored and finished using non-shrink grout.

3.6 CLEANOUTS

A. Construct on compacted 4" minimum depth 3/4" - 0 crushed rock base level, plumb, and square with adjacent surfaces. Set rim flush with adjacent finished surfaces unless otherwise noted.

3.7 TRENCH DRAIN

A. Install in accordance with manufacturer's recommendations as detailed on drawings. Utilize manufacturer's approved installation device to assure proper joints, drawn tightly together by device.

B. Construct on compacted 4" minimum depth 3/4" - 0 crushed rock base level, plumb, and square with adjacent construction. Set trench drain channel completely in place, and test flow from both directions of flow prior to pouring concrete. Set rim flush with adjacent finished surfaces unless otherwise noted.

3.8 BACKWATER VALVE

A. Install per manufacturer's recommendations and as detailed on drawings.

3.9 FIELD QUALITY CONTROL

A. Refer to Section 01 45 00 for responsibilities for arranging, supervising, and payment of field quality control requirements.

B. Field Inspections: Notify Engineer prior to work of this section.

C. Special Inspections for Code Compliance: Obtain plumbing inspector approvals.

3.10 CLEANING

A. Prior to final acceptance, Contractor shall flush and clean all elements of the completed system. All pipe and structures shall be clean and free of all construction debris, rocks, gravel, mud, sand, silt, and other foreign material, and as directed by the Engineer.

B. Upon completion of work of this section promptly remove from the working area all scraps, debris, and surplus material.

3.11 PROTECTION

A. Protect all work installed under this section.

B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

STORM DRAINAGE MANHOLES, FRAMES AND COVERS

PART 1 GENERAL

1.1 CONTRACT CONDITIONS

A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.2 SECTION INCLUDES

A. Flow control manhole for on-site private storm drain system improvements.

1.3 RELATED SECTIONS

A. Section 31 23 33 - Trenching and Backfill

B. Section 33 40 00 - Storm Drainage Utilities

1.4 SUBMITTALS

A. Comply with Section 01 33 00, unless otherwise indicated.

B. Product Data: Manufacturer's specifications and technical data including performance, construction and fabrication information.

1. Submit for flow control manhole, frame and cover.

C. Field Quality Control submittals as specified in Part 3 of this Section:

1. Field Tests

2. Special Inspections for Code Compliance.

D. Closeout Requirements: Comply with Section 01 77 00.

1. Provide record documents.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Not less than five years of experience in the actual production of specified products.

B. Installer's Qualifications: Firm with not less than five years of experience in installation of systems similar in complexity to those required for this Project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Deliver products in original, unopened packaging with legible manufacturer's identification.

B. Storage and Protection: Comply with manufacturer's recommendations.

1. Protect from damage by the elements and construction procedures.

1.7 ADVANCE NOTICES

A. Notify Engineer at least 48 hours before starting work of this section.

1.8 COORDINATION

A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.1 MANHOLE BASES, RISERS, AND CONES

A. Standard precast manhole sections shall conform to ASTM C478 (latest revision) and consist of circular sections in standard nominal diameters. No more than two lift holes shall be cast into each section. Holes shall be located so as to not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling in lieu of lift holes. Standard precast cones shall be concentric unless otherwise specified and shall conform to ASTM C478 (latest revision).

2.2 CONCRETE

A. Concrete shall be ready-mixed conforming to Section 03 30 00, CAST-IN-PLACE CONCRETE, and shall have a compressive strength of 3,000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

2.3 MORTAR

A. Cement mortar in precast manhole joint shall conform to ASTM C387 (latest revision) and consist of one part portland cement and two parts clean, well graded sand which will pass a 1/8" screen with water as necessary to obtain the consistency such that it will readily adhere to the precast concrete. Mortar shall be used within 30 minutes after it is prepared.

2.4 MANHOLE JOINT SEALANT

A. Preformed plastic gaskets, such as Kent Seal, or approved.

2.5 PLASTIC PIPE SEALANT

A. At PVC pipe penetrations: KOR-N-SEAL Boot or approved.

2.6 MANHOLE FRAMES AND COVERS

A. Manhole frames shall have a 24" clear frame opening. Bearing and wedging surface shall be machined to ensure a tight fit of the cover and to prevent rocking.

B. Covers, grates, and frames shall be cast iron conforming to ASTM A48 (latest revision), Class 30. Covers shall be locking.

C. Cover shall be marked "storm" or other appropriate marking to indicate storm drain system.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to starting work of this section, carefully inspect trench, excavations, and base to verify that all such work is complete to the point where this installation may properly commence.

B. Do not install work of this section until unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.

C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.2 EXCAVATION AND BACKFILL

A. Excavation and backfill shall conform to the requirements of Section 31 23 33, TRENCHING AND BACKFILL.

3.3 MANHOLE BASES (WITH SUMP)

A. Manhole bases shall be precast. Base sections shall be constructed to form a watertight structure.

B. Construct on 4" minimum depth, 3/4"-0 crushed rock base; level and plumb.

3.4 PIPE OPENINGS

A. *Additional detail and information will be provided at a subsequent submittal for the flow control elements of the manhole.*

B. Openings to receive pipe shall be circular, tapered in toward the inside of the section and held to the minimum size possible to accommodate the pipe to be inserted and to effectively seal the joints.

C. For PVC pipe make manhole connections using KOR-N-SEAL Boot.

D. For corrugated pipe, make manhole connections using cement bender product X or approved.

E. Trim pipe ends flush with manhole interior wall. Grout between pipe and manhole for a smooth transition.

3.5 JOINT SEALING

A. Pipe gaskets shall be installed in conformance with the manufacturer's recommendations. All mortar joints shall be clean and wet before setting risers and tops in a full bed of Portland cement mortar. Joints shall be watertight, grouted inside and have a smooth finish. Outside joints shall be grouted before backfilling.

3.6 GRADE RINGS

A. Grade rings shall be laid in mortar with the sides plumb and the top level. The joints shall be sealed with mortar. The extensions shall be watertight.

3.7 MANHOLE FRAMES AND COVERS

A. Frames shall be set in a bed of mortar. Frames shall be set so the rim is flush with adjacent surfaces unless otherwise noted on drawings. Frames and covers shall be installed in such a manner as to prevent infiltration of surface or ground water between the frame and the concrete of the manhole section.

3.8 FIELD QUALITY CONTROL

A. Refer to Section 01 45 00 for responsibilities for arranging, supervising, and payment of field quality control requirements.

B. Field Inspections: Notify Engineer prior to backfilling.

C. Special Inspections for Code Compliance:

1. Obtain plumbing inspector approvals and submit to Engineer.

3.9 CLEANING

A. Prior to final acceptance, Contractor shall flush and clean all elements of the completed systems. All manholes shall be clean and free of all construction debris, rocks, gravel, mud, sand, silt, and other foreign material, and as directed by the Engineer.

B. Upon completion of work of this section, promptly remove from the working area all scraps, debris, and surplus material.

3.10 PROTECTION

A. Protect all work installed under this section.

B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION