



DULUTH INTERNATIONAL AIRPORT

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**DULUTH INTERNATIONAL AIRPORT
NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
BID PACKAGE 2D
ISSUE FOR BID**

FAA AIP No. - 3-27-0024-55-13
RS&H PROJ. No. – 2131882.114
CITY OF DULUTH BID No. 13-4401

**PROJECT MANUAL
VOLUME 2 OF 2**

Date: MAY 15, 2013



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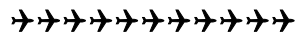


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**SECTION 03 10 00
CONCRETE FORMWORK**

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 specifies formwork for cast-in-place concrete for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Concrete toppings.
 - 6. Building walls.
- B. Related Sections include the following:
 - 1. Division 01 Section "Structural Testing and Special Inspections".
 - 2. Division 03 Section "Concrete Reinforcement".
 - 3. Division 03 Section "Cast-In-Place Concrete".
 - 4. Division 04 Section "Unit Masonry" for wedge-type inserts and dovetail slots.
 - 5. Division 05 for embedded items.

1.3 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 117 – Specifications for Tolerance for Concrete Construction and Materials
 - 2. ACI 301 – Specification for Structural Concrete for Buildings.
 - 3. ACI 318 – Building Code Requirements for Structural Concrete.
 - 4. ACI 347 – Guide to Formwork for Concrete.
- B. American Plywood Association (APA) - Product Standard PS1, Construction and Industrial Plywood.
- C. American Society for Testing and Materials (ASTM).
- D. U. S. Green Building Council – Green Building Design and Construction Reference Guide.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Formwork Shop Drawings: Prepared by or under the supervision of a Specialty Structural Engineer detailing fabrication, assembly, and support of formwork.
 - 1. Engineering Responsibility: Formwork, bracing, shoring, and reshoring design for construction loads are sole responsibility of Installer's Specialty Structural Engineer.

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DULUTH, MINNESOTA**

**SECTION 03 10 00 – CONCRETE
FORMWORK**

- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Form materials and form-release agents.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittal Schedule for all action submittal items.
- B. Minutes of Pre-Installation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Specialty Structural Engineer Qualifications: Employ professional Engineer, registered in Minnesota, to perform design of formwork, shoring, and reshoring for construction loads. Sign and seal design Shop Drawings submitted to Owner for review.
- C. Mockups: Cast concrete formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
 - 1. Build panel approximately 100 sq. ft. for formed surface in the location indicated if directed by Architect.
 - 2. Approved panels may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
 - 1. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, etc.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.

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FORMWORK**

- b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Soil Retainers: Material to be rigid and non-degradable.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. 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 exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Work shall conform to ACI 117 and ACI 301, except as modified by requirements of these Contract Documents.
- B. Design, erect, shore, brace, and maintain formwork, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated.
- D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

**CONCRETE FORMWORK
ISSUE FOR BID
03 10 00 - 3**

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**SECTION 03 10 00 – CONCRETE
FORMWORK**

1. Class A, 1/8 inch for smooth-formed finished surfaces.
 2. Class B, 1/4 inch for rough-formed finished surfaces.
- E. Construct forms tight enough to prevent loss of concrete mortar.
- F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. Form openings, chases, offsets, recesses, keyways, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- K. Fastening Devices for Other Work:
1. Provide for installation of inserts, reglets, hangers, metal ties, anchor bolts and other fastening devices required for attachment of other work.
 2. Properly locate fastening devices in cooperation with other trades and secure position before concrete is placed.
 3. Where concrete surfaces are veneered with masonry, install masonry anchor slots.
 - a. In concrete forms set vertically 2'-0" on center.
 - b. Install two continuous slots per face at each column face wider than 1'-4".
 4. Where masonry abuts concrete surface, install one continuous masonry anchor slot in concrete forms set vertically for each eight inches width of masonry, centered in masonry width.
- L. Install sleeves in concrete piers, columns, beams or joists only upon approval of the Architect.
- M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF VOID FORMS AND SOIL RETAINERS

- A. Placement:
1. Place forms on smooth, level, firm, dry surface.

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2. Butt carton forms tightly end to end and side to side, seam side down.
 3. Place cover sheets on carton forms and staple.
- B. Moisture Protection:
1. Do not let carton forms become wet.
 2. Remove and replace wet cartons.
- C. Place soil retainers at edge of grade beams.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 75% its 28-day design compressive strength.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified special inspector and independent testing agency to perform field tests and inspections and prepare test reports. Cooperate with testing agency to facilitate the execution of its duties.
- B. Inspect formwork prior to concrete placement to verify resulting element width, depth and length correspond to those indicated on formwork installation drawings and Contract Documents.
- C. Where special formed surface finish requirements are required, verify forming materials comply with requirements.
- D. Adequacy of formwork, shoring, and reshoring to support vertical and lateral loads during construction is sole responsibility of Contractor.

END OF SECTION 03 10 00

**SECTION 03 20 00
CONCRETE REINFORCEMENT**

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. Reinforcing bars for cast-in-place concrete.
 - 2. Smooth bar dowels and diamond dowels and dowel baskets for concrete slab joints.
 - 3. Deformed bar anchors and headed shear connectors.
 - 4. Couplers for reinforcing bars.
 - 5. Welded wire fabric.
 - 6. Ties and supports for reinforcement.
- B. Related Sections:
 - 1. Division 01 Section "Structural Testing and Special Inspections".
 - 2. Division 03 Section "Concrete Formwork".
 - 3. Division 03 Section "Cast-In-Place Concrete".

1.3 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 – Specification for Structural Concrete.
 - 3. ACI 315 - Standards on Details and Detailing of Concrete Reinforcement.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete.
- B. American Society for Testing and Materials (ASTM).
- C. American Welding Society (AWS):
 - 1. AWS D1.1 - Structural Welding Code - Steel.
 - 2. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- D. Concrete Reinforcing Steel Institute (CRSI):
 - 1. Manual of Standard Practice.
 - 2. Placing Reinforcing Bars.
- E. U. S. Green Building Council – Green Building Design and Construction Reference Guide.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Submit in accordance with ACI 315, "Standards on Details and Detailing of Concrete Reinforcement"

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1. Provide necessary plan, elevation and section detail placing drawings that illustrate fabrication, bending, and placement of reinforcement.
 2. Include bar sizes, lengths, material, and grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Welding certificates – signed by contractor certifying that welders comply with requirements of Article 1.5 – “Quality Assurance.

1.5 INFORMATIONAL SUBMITTALS

- A. Minutes of Pre-Installation conference.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator utilizing experienced detailers who have successfully completed CRSI's Reinforcing Bar Detailer Program.
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- C. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-Reinforcing Steel."
- D. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1. Review special inspection and testing and inspecting agency procedures for field quality control, steel reinforcement installation, and protection during concrete placement.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

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- C. Deformed Bar Anchors (DBA): Standard fluxed ASTM A496 deformed bars prepared for stud welding.
 - 1. Available Manufacturers:
 - a. Erico Fastening.
 - b. Nelson Stud Welding.
- D. Headed Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
 - 1. Available Manufacturers:
 - a. Erico Fastening.
 - b. Nelson Stud Welding.
- E. Epoxy-Coated Reinforcing Bars: ASTM A 615, Grade 60, deformed bars, ASTM A 775, epoxy coated.
- F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 JOINT DOWELS

- A. Dowel Caps: Plastic material of size recommended for rod diameter.
- B. Smooth Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burr. Provide dowel ends that are sawn with round ends, not sheared with crimped ends.
- C. Smooth Dowel Support Baskets:
 - 1. Available Manufactures:
 - a. American Highway Technology.
- D. Smooth Dowel Coating: Grease or bituminous coating.
- E. Diamond Plate Dowels: Saw cut from ASTM A 36 hot rolled plate.
 - 1. Available Products:
 - a. Diamond Dowel™ by PNA, Inc.
- F. Smooth Plate Dowels and Baskets:
 - 1. Approved Manufacturers:
 - a. PNA, Inc.

2.4 REINFORCEMENT ACCESSORIES

- A. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775.
 - 1. Available Products:
 - a. 3M Scotchkote 213PC or liquid, two-part, epoxy repair coating or approved equal.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, or plastic according to CRSI's "Manual of Standard Practice," and as follows:

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1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- C. Supports for Slabs-On-Grade with Steel Reinforcement: Use supports with sand plates or horizontal runners.
1. Dayton Richmond: Aztec E-Z Chair – PEZ with E-Z Chair Sand Plate PSP.
 2. General Technologies, Inc.: Composite Chairs on Sand Plates.

2.5 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice" and accepted shop drawings.
- B. Do not re-bend or straighten steel reinforcement except where specifically accepted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" and accepted shop drawings for placing reinforcement. Adjust reinforcing to avoid sleeves, blockouts and other voids in concrete.
- B. Underfloor Vapor Retarders: When chairing reinforcement on top of underfloor vapor retarders, use only supports with integral sand plates.
1. Do not cut or puncture vapor retarder.
 2. Repair damage and reseal cuts or punctures in vapor retarder before placing concrete.
- C. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- D. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4, where indicated.
- E. Provide bar supports in sufficient number and heavy enough to carry steel they support. Place no bar more than 2 inches beyond last leg of continuous bar support. Do not use bar supports to support runways for concrete buggies, or similar loads.
1. Maximum support bar spacing shall not exceed 48 inches.
 2. Maximum bolster spacing shall not exceed 36 inches for #4 support bar or 48 inches for #5 support bar.
- F. Bar supports on ground may be concrete block for slab depth of 7 inches or less and if positioned in staggered pattern. Provide bar chairs with sand feet where slab thickness exceeds 7 inches.
- G. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

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- H. Steel reinforcement partially embedded in concrete shall not be field bent, except as indicated or permitted by Structural Engineer.
- I. For walls reinforced on both faces, provide spreader bars and chairs to surfaces of forms on each side at spacings not to exceed 8 feet in either direction. For walls with single layer of reinforcing, provide chairs each side at spacings not to exceed 8 feet in either direction.
- J. Install epoxy coated reinforcing bars using either epoxy or plastic coated tie wires. Place epoxy coated steel on epoxy coated bar supports. Patch cut ends and areas of damage.
- K. Install welded wire reinforcement in longest practicable lengths. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- L. Install diamond plate dowels in concrete slab-on-grade joints where shown. Install diamond plate dowels per manufacturer's written instructions.

3.2 PROTECTION AND REPAIR

- A. Install additional bar supports at locations where reinforcement position is not maintained due to collapsed chairs or construction activity from time of original placement.
- B. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.3 FIELD QUALITY CONTROL

- A. Assign individual to monitor reinforcement position during concrete placement and reposition bars that are displaced due to construction activity.
- B. Testing and Inspecting: Owner will engage a qualified special inspector and material testing agency to perform field quality control inspections and testing in accordance with Division 01 Section "Structural Tests and Inspections" and as specified herein.
- C. Submit reports of inspections and material testing as soon as practical after they are made.
- D. Inspect reinforcement in all cast-in-place concrete footings, foundation frost walls, basement walls, and columns, excluding slabs on grade, footings without transverse reinforcement, and topping slabs. (Technical I).
- E. Inspect reinforcement in all cast-in-place concrete retaining walls and elevated structural slabs. (Structural I).
- F. Verify reinforcing bar grade.
- G. Verify reinforcing bars are free of dirt, excessive rust and damage.
- H. Verify reinforcing bars are adequately tied, chaired and supported to prevent displacement during concrete placement.
- I. Verify proper clear distances between bars and to surfaces of concrete.

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- J. Verify reinforcing bar size and placement.
- K. Verify bar laps for proper length and stagger and bar bends for minimum diameter, slope and length.
- L. Verify mechanical splices are placed in accordance with Contract Documents and reviewed shop drawings.
- M. Verify epoxy coating is present at locations noted on the Contract Documents; include tie wires, chairs, bolsters, etc. Verify coating damage is repaired in accordance with the Contract Documents.
- N. Verify installation of anchor rods, embedded plates and angles are placed in accordance with the Contract Documents.
- O. Correct work that does not comply with specified requirements prior to scheduling concrete placement.
- P. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

END OF SECTION 03 20 00

**SECTION 03 30 00
CAST-INPLACE CONCRETE**

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 specifies cast-in place concrete, vapor retarder, concrete materials, mixture design, placement procedures, finishes and all related accessories, for the following:
1. Footings.
 2. Foundation walls and piers.
 3. Slabs-on-grade.
 4. Columns.
 5. Concrete toppings.
 6. Base slabs.
 7. Miscellaneous concrete items.
 8. Placement of embedded items provided by other trades
- B. Related Requirements:
1. Division 01 Section "Structural Tests and Special Inspections".
 2. Division 03 Section "Concrete Formwork".
 3. Division 03 Section "Concrete Reinforcement".
 4. Division 03 Section "Concrete Topping".
 5. Division 04 Section "Unit Masonry" for wedge type inserts and dovetail slots.
 6. Division 05 Sections for items cast into concrete.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Organization (AASHTO): M182 Burlap Cloth made from Jute or Kenaf.
- B. American Concrete Institute (ACI):
1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
 2. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete.
 3. ACI 301 - Specifications for Structural Concrete for Buildings.
 4. ACI 302 – Guide for Concrete Floor and Slab Construction.
 5. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
 6. ACI 305 - Hot Weather Concreting.
 7. ACI 306 - Cold Weather Concreting.
 8. ACI 308 – Standard Practice for Curing Concrete.
 9. ACI 308.1 – Standard Specification for Curing Concrete.
 10. ACI 309 - Guide for Consolidation of Concrete.
 11. ACI 318 - Building Code Requirements for Structural Concrete.
- C. American Institute of Steel Construction (AISC): Code of Standard Practice for Buildings and Bridges.

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- D. American National Standards Institute (ANSI): NSF Standard 61.
- E. American Society for Testing and Materials (ASTM).
- F. Council of American Structural Engineers of Minnesota (CASE/MN): Guideline for Special Structural Inspection and Testing.
- G. International Building Code (IBC).
- H. Minnesota State Building Code (MSBC).
- I. National Ready Mixed Concrete Association (NRMCA): Certification of Ready Mixed Concrete Production Facilities.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Form-release agents
 - 2. Concrete Admixtures.
 - 3. Curing Materials.
 - 4. Joint Fillers.
 - 5. Waterstops.
 - 6. Floor and Slab Treatments.
 - 7. Bonding Agents.
 - 8. Adhesives.
 - 9. Repair Materials
- B. Concrete Mix Designs: Each concrete mix design submittal shall contain the following information:
 - 1. Mix Number (which will correspond to mix ticket on trucks delivered to site).
 - 2. Application for which concrete is designed (i.e. – footings, slabs, etc...)
 - 3. Applicable mix performance criteria including:
 - a. Final Design strength at 28 days.
 - b. Unit Weight.
 - c. Air Content.
 - d. Slump (with water only and after addition of WRA and/or HRWRA).
 - e. For shrinkage compensating concrete, provide results of restrained prism expansion tests, ASTM C878, with mix design.
 - 4. Applicable mix ingredients including quantities, ASTM designations, and sources for:
 - a. Cementitious materials.
 - b. Aggregate source, geological type, size, and shape.
 - 1) Include total gradation for combined coarse and fine aggregates for mixes specified to contain Well Graded Aggregate.
 - 2) Included calculated Coarseness Factor and Workability Factor for mixes specifying limits on these values.
 - c. Water.

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- 1) Indicate amount of mixing water to be withheld for later addition at Project site.
 - d. Water cementitious materials ratio, w/cm.
 - e. Admixtures.
 - f. Fibers, color pigments, and other additions.
 5. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Proposed construction joint and saw-cut contraction joint locations for slabs-on-grade.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittal Schedule for all action submittal items.
- B. Manufacturer's Instructions for each type of product indicated:
1. Curing and Sealing Compounds.
 2. Joint Fillers.
 3. Waterstops.
 4. Floor and Slab Treatments.
 5. Bonding Agents.
 6. Adhesives.
 7. Repair Materials.
- C. Preconstruction Material Test Reports:
1. Cementitious Materials.
 2. Compressive strength results of trial batches or historical test data, in accordance with ACI 318 Chapter 5, indicating following:
 - a. Specified compressive strength, f'_c .
 - b. Average compressive strength, f'_{cr} .
 - c. Number of consecutive tests.
 - d. Overall standard deviation.
 - e. Overall coefficient of variation.
 - f. Minimum moving average of three consecutive strength tests.
 3. Aggregate gradation, specific gravity, and absorption.
 4. Aggregate potential alkali-silica reactivity (ASR) for concrete in exterior, corrosive, or wet environments in accordance with ASTM C 289.
- D. Minutes of Pre-Installation conference.
- E. Construction Test Reports:
1. Concrete tests.
 2. Floor tolerance measurement.
 3. Industrial floor joint filler inspection.

1.7 CLOSEOUT SUBMITTALS

- A. Floor Correction Agreement: Submit written floor slab extended correction period agreement in duplicate within ten days after date of Substantial Completion.
- B. Maintenance Contracts:
1. Curing and Sealing Compounds.
 2. Floor and Slab Treatments.

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- C. Operation and Maintenance Data:
 - 1. Curing and Sealing Compounds.
 - 2. Floor and Slab Treatments.
- D. Bonds:
- E. Warranty Documentation:
- F. Record Documentation.
- G. Sustainable Design Closeout Documentation.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain materials from same source throughout Work.
- E. Contractor shall assign a qualified staff member to perform quality control on their own work in the field on a daily basis, for each day work is performed. The Contractor's quality control staff shall review their own work for compliance with contract documents before the Contractor notifies the design team of readiness for required inspections, tests and observations to be provided by the Owner's Representatives.
- F. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination" and Division 01 Section "Structural Tests and Special Inspections".
 - 1. Review installer qualifications, methods, scheduling and testing procedures before work is started.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, steel reinforcement installation, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi rigid joint fillers, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
 - 3. Authorized representatives of concrete supplier, industrial floor supplier and installer, floor finisher, testing and inspection agency, admixture supplier, steel fiber reinforcement supplier, Engineer, Owner and Construction Manager.

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1.9 DELIVERY, STORAGE, AND HANDLING

- A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- B. Joint Filler, Joint Sealers and Curing Materials: Deliver in original factory packaging and unopened containers and protect from damage and contamination.

1.10 SITE CONDITIONS

- A. Provide total building enclosure including weather tight roof and walls before placing interior concrete slabs with exception of base slab for two-stage floor.
- B. During installation of interior slabs on grade, close openings in exterior walls and roofs enclosing areas.
- C. Provide minimum interior temperature 50 degrees F during installation and curing.
- D. Vent heaters or combustion equipment to outside.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 CONCRETE MATERIALS

- A. Cementitious and Pozzolanic Materials: Use the following materials, of the same type, brand, and source for each required type of concrete and on which selection of concrete proportions was based:
 - 1. Portland Cement: ASTM C 150, Type I or Type I/II.
 - a. For exposed concrete, use same brand throughout.
 - 2. Fly Ash: ASTM C 618, Class C or F, and as specified herein.
 - a. Available Alkalis, as Na₂O equivalent: 1.5% maximum
 - b. Loss On Ignition (LOI): 1% maximum
 - c. Calcium Oxide Limit (CaO): 20% maximum
 - 3. Replacement Ratio: Portland cement shall be replaced on an equal mass (not weight) basis. Material replacements shall be expressed as a percent, by mass, of the total cementitious materials content, with proportions selected for 28 day compressive strengths equal to those specified. The change in volume resulting from the substitutions shall be determined and an adjustment in both coarse and fine aggregate proportions shall be determined in order to ensure a unit volume.
 - a. Fly Ash replacement shall not exceed 30% for Class C or 20% for Class F.

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- B. Normal-Weight Aggregates: ASTM C 33. Do not use aggregates containing soluble salts or other substances which can cause stains on exposed surfaces. Use aggregates from one source of supply corresponding to that on which selection of concrete proportions was based.
1. Coarse Aggregate: Minimum Class Designation:
 - a. Class 3S Typical
 - b. Class 4S Exterior horizontal concrete
 - 1) Maximum absorption 1.7%
 - c. Class 5S Exterior exposed architectural concrete
 - 1) Maximum absorption 1.7%
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement
- C. Water: ASTM C 94 and potable.

2.3 ADMIXTURES

- A. General: 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. Do not use admixtures containing calcium chloride or thiocyanates.
- B. Air-Entraining Admixture (AEA): ASTM C 260.
1. Available Products:
 - a. BASF: MB AE 90 or Micro Air.
 - b. Euclid Chemical Company: Air-Mix.
 - c. General Resource Technology: Polychem AE.
 - d. Grace Construction Products: Daravair series or Darex series.
 - e. Protex Industries: Protex AES.
- C. Water-Reducing Admixture (WRA): ASTM C 494, Type A.
1. Available Products:
 - a. BASF: Pozzolith 210 or Pozzolith 322 N
 - b. Euclid Chemical Company: Eucon WR-75.
 - c. General Resource Technology: Polychem 1000.
 - d. Grace Construction Products: WRDA.
- D. Mid-Range Water-Reducing Admixture (MRWRA): ASTM C 494, Type A.
1. Available Products:
 - a. BASF: Polyheed 997 or Polyheed FC100.
 - b. Euclid Chemical Company: Eucon A+.
 - c. General Resource Technology: KB-1000.
 - d. Grace Construction Products: Daracem-65.
- E. Polycarboxylate High-Range Water-Reducing Admixture (HRWRA): ASTM C 494, Type F.
1. Available Products:
 - a. BASF: Glenium 3000 NS, 3030 NS, or 3200 HES.
 - b. Euclid Chemical Company: Plastol 5000.
 - c. Grace Construction Products: ADVA.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type B and D.
1. Available Products:
 - a. BASF: Pozzolith 80 or Pozzolith 200 N.
 - b. Euclid Chemical Company: Eucon Retarder-75.
 - c. General Resource Technology: Polychem R.

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d. Grace Construction Products: Daratard 17.

- G. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures effectively containing chloride ions (more than 0.05 percent) are not permitted.

2.4 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
1. Available Products:
 - a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
 - b. Concrete Sealants Inc.; Conseal CS-231.
 - c. Greenstreak; Swellstop.
 - d. Henry Company, Sealants Division; Hydro-Flex.
 - e. JP Specialties, Inc.; Earthshield Type 20.
 - f. Progress Unlimited, Inc.; Superstop.
 - g. TCMiraDRI; Mirastop.

2.5 MISCELLANEOUS EMBEDDED ITEMS

- A. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
1. Nuts: ASTM A 563 heavy hex carbon steel.
 2. Plate Washers: ASTM A 36 carbon steel.
 3. Washers: ASTM F 436 hardened carbon steel.
- B. Miscellaneous angles, channels, and plates: ASTM A 36.
- C. Reglets: Fabricate reglets of not less than 0.0217-inch- thick (26-ga.), galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
1. Available Manufacturers:
 - a. Gateway Building Products.
 - b. Heckman Building Products.
 - c. Hohmann-Bernard.
- D. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick (22-ga.), with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
1. Available Products:
 - a. Gateway Building Products: Beehive Slot.
 - b. Heckman Building Products: No. 100.
- E. Stair Nosings:
1. Available Products:
 - a. Wooster Products: Spectra Type WP4C.

2.6 CURING, CLEANING, AND SEALING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Available Products:
 - a. BASF: Confilm

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- b. Burke by Edoco; BurkeFilm.
 - c. ChemMasters; Spray-Film.
 - d. Conspec; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film.
 - f. Euclid Chemical Company; Eucobar.
 - g. Kaufman Products, Inc.; Vapor Aid.
- B. Water Cure:
 - 1. Waterproof paper.
 - 2. Reef Industries: Transguard Economy Grade. (ASTM C 171, 20-mils thick, polypropylene sheet with nonperforated white coating.)
 - 3. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
 - 4. Dayton Bag and Burlap: Burlene.
 - 5. Reef Industries: Transguard 4000; 42-mil thick, fiber mat with polyethylene sheet backing.
- C. Water: ASTM C 94 and potable.
- D. Concrete Floor Cleaner and Stripper:
 - 1. Available Products:
 - a. Burke by Edoco; Burke Klean.
 - b. Dayton Superior Corporation; Citrus Peel (J-48).
 - c. Euclid Chemical Company; Euco Clean & Strip.
 - d. Kaufman Products, Inc.; K Pro CD.
 - e. L&M Construction Chemicals, Inc.; Citrex.
- E. Penetrating Liquid Densifier and Sealer: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Available Products:
 - a. Burke by Edoco; Titan Hard.
 - b. ChemMasters; Chemisil Plus.
 - c. Curecrete Distribution Inc.; Ashford Formula.
 - d. Dayton Superior Corporation; Day-Chem Sure Hard.
 - e. Euclid Chemical Company; Euco Diamond Hard.
 - f. Kaufman Products, Inc.; SureHard.
 - g. L&M Construction Chemicals, Inc.; Seal Hard.
 - h. Meadows, W. R., Inc.; Liqui-Hard.

2.7 JOINT MATERIALS

- A. Equipment Control joint saw:
 - 1. Available Products:
 - a. Soff-Cut International; "Soff-Cut System," early-entry dry-cut saw with Skid Plate.
- B. Expansion Joint Material: ASTM D 1751, asphalt-saturated cellulosic fiber.
 - 1. Available Manufacturers:
 - a. W.R. Meadows.
 - b. BASF.

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- C. Joint Backer Rod: Flexible, compressible, closed-cell polyethylene foam, not less than 10 psi compression deflection.
- D. Joint Filler-Industrial Slabs: Two-component, semi rigid, 100 percent solids, per ASTM D 2240.
 - 1. Metzger/McGuire, MM80.
 - 2. Metzger/McGuire, SPAL-PRO RSF at freezers.
- E. Interior Joint Sealer: Mameco, Vulkem 45.
- F. Interior Bond Breaker Joint: 30 pound asphalt felt, without perforations.

2.8 RELATED MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Under Slab Vapor Retarder: ASTM E1745, Class A.
 - 1. Manufacturers and Products:
 - a. Barrier Bac, Inc., VB250 or VB350.
 - b. Raven Industries, Vapor Block 10 or 15.
 - c. Reef Industries, Inc., Vaporguard.
 - d. Stego Industries, Stego Wrap Vapor Barrier 15 mil.
 - 2. Accessories:
 - a. Seam tape: High density polyethylene tape with pressure sensitive adhesive, minimum 4 inches wide.
 - b. Pipe boots: Constructed from vapor barrier membrane and seam tape.

2.9 REPAIR MATERIALS

- A. Repair 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 underlayment 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 underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109.
- B. Repair Overlayment: 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 4000 psi at 28 days when tested according to ASTM C 109/C 109M.

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2.10 CONCRETE MIXING

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, with exceptions specified herein, and ASTM C 1116 where fibers are used, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- C. Admixtures: Use approved admixtures according to manufacturer's written instructions.
 - 1. Use chemical admixtures in concrete, as required, for placement, workability, durability, and controlled set time.
- D. Air Content: Do not allow air content of hard-troweled finished floors to exceed 3 percent.
- E. Concrete Slump Limits: Measured according to ASTM C 143 at point of placement.
 - 1. 4 inches without water reducing admixtures
 - 2. 5 inches after addition of WRA or MWRA.
 - 3. 7 inches after addition of HRWRA.
 - 4. A tolerance of up to one inch above indicated maximum will be allowed for one batch in any five consecutive batches tested.
 - 5. If the maximum water-cement ratio is not exceeded, concrete arriving at the jobsite within 60 minutes of the initial batching that has a slump less than the maximum allowed may have water added when accepted by the project inspector.
 - 6. Water reducing admixtures will not be incorporated in combination with shrinkage compensating concrete unless approved by the Engineer.
 - 7. Water reducing admixtures may be added to increase the slump when water can not be added and additional slump is necessary for workability when accepted by the project inspector.
 - 8. Water shall not be added to the mix after any supplemental water reducing admixtures have been dosed into the mixer.
- F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:

| Item | Requirements |
|--|--------------|
| Compressive Strength at 28 days (min), f'_c | 3000 psi |
| Maximum Cementitious Content | 520 lb/cy |
| Maximum water/cementitious materials ratio, w/cm | 0.50 |
| Cementitious Materials | |
| Portland Cement, Type I or Type I/II | 70%-100% |
| Supplementary Cementitious Materials | 0%-30% |
| Top Size Aggregate | 1-1/2 inch |

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- B. Foundation Walls and Piers: Proportion normal-weight concrete mixture as follows:

| Item | Requirements |
|--|----------------------|
| Compressive Strength at 28 days (min), f'_c | 4000 psi |
| Maximum Cementitious Content | 520 lb/cy |
| Maximum water/cementitious materials ratio, w/cm | 0.45 |
| Cementitious Materials Portland Cement, Type I or Type I/II Supplementary Cementitious Materials | 80%-100% 0%-20% |
| Top Size Aggregate | 1-1/2 inch |
| Air Content (at point of placement) at un-insulated exterior foundation walls | 5.5% ($\pm 1.5\%$) |

- C. Columns and Foundation Piers: Proportion normal-weight concrete mixture as follows:

| Item | Requirements |
|--|----------------------|
| Compressive Strength at 28 days (min), f'_c | 4000 psi |
| Maximum Cementitious Content | 520 lb/cy |
| Maximum water/cementitious materials ratio, w/cm | 0.45 |
| Cementitious Materials Portland Cement, Type I or Type I/II Supplementary Cementitious Materials | 80%-100% 0%-20% |
| Top Size Aggregate | 3/4 inch |
| Air Content (at point of placement) at un-insulated exterior foundation walls | 5.5% ($\pm 1.5\%$) |

- D. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

| Item | Requirements |
|--|-------------------------|
| Compressive Strength at 28 days (min), f'_c | 4000 psi |
| Maximum Cementitious Content | 520 lbs/yd ³ |
| Maximum water/cementitious materials ratio, w/cm | 0.44 |
| Cementitious Materials Portland Cement, Type I or Type I/II Supplementary Cementitious Materials | 80%-100% 0%-20% |
| Top Size Aggregate | 3/4 inch |
| Air Content (at point of placement) for slabs exposed to freezing and thawing | 5.5% ($\pm 1.5\%$) |

- E. Suspended Slabs-On-Metal Deck: Proportion normal-weight concrete mixture as follows:

| Item | Requirements |
|--|---|
| Compressive Strength at 28 days (min), f'_c | 4000 psi |
| Equilibrium Unit Weight | 150 lbs/ft ³ (± 3 lbs/ft ³) |
| Cementitious Materials Content | 520 lbs/yd ³ |
| Maximum water/cementitious materials ratio, w/cm | 0.44 |
| Cementitious Materials | |

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| | |
|--------------------------------------|------------|
| Portland Cement, Type I or Type I/II | 80%-100% |
| Supplementary Cementitious Materials | 0%-20% |
| Top Size Aggregate | 3/4 inch |
| Coarseness Factor | 52-70 |
| Air Content (at point of placement) | 3% maximum |

- F. Concrete Topping Slabs: Proportion normal-weight concrete mixture as follows:

| Item | Requirements |
|--|-------------------------|
| Compressive Strength at 28 days (min), f'_c | 4000 psi |
| Maximum Cementitious Content | 564 lbs/yd ³ |
| Maximum water/cementitious materials ratio, w/cm | 0.42 |
| Cementitious Materials | |
| Portland Cement, Type I or Type I/II | 70%-100% |
| Supplementary Cementitious Materials | 0%-30% |
| Top Size Aggregate | 1/2 inch |

- G. Miscellaneous Concrete Items: Concrete stair pan fill, curbs, housekeeping pads, etc. Proportion normal-weight concrete mixture as follows:

| Item | Requirements |
|--|--------------|
| Compressive Strength at 28 days (min), f'_c | 3000 psi |
| Maximum water/cementitious materials ratio, w/cm | 0.45 |
| Cementitious Materials | |
| Portland Cement, Type I or Type I/II | 70%-100% |
| Supplementary Cementitious Materials | 0%-30% |
| Top Size Aggregate | 1/2 inch |

PART 3 - EXECUTION

3.1 GENERAL

- A. Work shall conform to ACI 117 and ACI 301, except as modified by requirements of these Contract Documents.

3.2 PREPARATION

- A. Verify actual locations of existing structure, new work previously placed and other construction to which the new work must fit by accurate field measurements before submittal of related shop drawings or fabrication; show recorded measurements on shop drawings submitted for review. Coordinate fabrication schedule with construction progress to avoid delay of Work. Where work will be connected to existing masonry or concrete, contractor shall engage a testing agency to pre-locate hidden embeds and reinforcing steel prior to submittal of shop drawings. Provide templates and dimensions to fabricator for accurate alignment with existing conditions. Show field conditions impacting the work on the shop drawings, prior to submittal.

3.3 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install wedge inserts for masonry shelf angle supports and sleeves for pipe and conduit.
 - 4. Install dovetail anchor slots in concrete structures as indicated.

3.4 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect and Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
 - 2. Form joints with keyways and/or dowels as detailed. Embed keys at least 1-1/2 inches into concrete.
 - 3. Unless detailed otherwise, locate joints for beams, suspended slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as indicated on the drawings.
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with early-entry dry-cut power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 - a. Install cuts 0 to 2 hours after final finishing and prior to final set.
 - b. Install joint protector at saw-cut intersections prior to cross cut.
 - 3. Provide cleanly cut, straight joints in toppings over joints in base slab.
 - 4. Do not saw cut slabs on metal deck.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install expansion joint material at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

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1. Extend expansion joint material full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 2. Terminate full-width expansion joint material not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 3. Install expansion joint material in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Curbs: Provide control joints in poured in place concrete curbs 10 feet o.c. maximum spacings with expansion joints not over 40 feet o.c. Make control joints by cutting approximately 1/8 inch wide by one inch to 1-1/2 inch deep into exposed surfaces. Expansion joints shall be 1/2 inch wide with expansion joint material. At curbs adjacent to sidewalks, align joints in curb and sidewalk.

3.5 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.6 INSTALLING UNDER SLAB VAPOR RETARDER

- A. Install according to membrane manufacturer's current published instructions and ASTM E1643.
- B. Install over level granular base and under reinforcing and slabs on grade.
- C. Lap over footings and seal to foundation walls.
- D. Overlap membrane joints minimum 6 inches and seal continuously with seam tape.
- E. Seal penetrations and pipes with pipe boot fashioned from membrane and sealed with seam tape.
- F. Repair damaged membrane with patches of membrane overlapping damage minimum 6 inches and sealing completely with seam tape.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding water-reducing admixtures to mixture.
- C. Clean forms, reinforcing and accessories and lubricate forms prior to placing concrete.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

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1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
 4. Do not insert vibrators to bottom of slabs-on-grade with under floor vapor retarders to avoid damaging this membrane.
 5. Do not allow concrete to drop freely more than 4 feet.
 6. Use approved chutes equipped with suitable hoppers for placing where required.
 7. Place at rate that concrete is always plastic and flows readily into every space.
 8. Place beams, girders and haunches monolithically with floor system.
 9. Wait until concrete in columns and walls is no longer plastic before casting beams, girders or slabs supported by them.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Before concrete slabs on grade are placed, verify that granular base is level and compacted.
 2. Sprinkle base to eliminate suction of water from concrete.
 3. Place interior slabs only after permanent walls and roof enclose slab area.
 4. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 5. Maintain reinforcement in position on chairs during concrete placement.
 6. Do not insert vibrators to bottom of slabs-on-grade with under floor vapor retarders to avoid damaging this membrane.
 7. Screed slab surfaces with a straightedge and strike off to correct elevations.
 8. Slope surfaces uniformly to drains where required.
 9. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Do not use concrete that has partially hardened or been contaminated by foreign materials, nor concrete that has been retempered or remixed after initial set.
- G. Before depositing new concrete on or against concrete that has set at construction joints, clean, wet and apply bonding agent to existing surfaces. Tighten forms prior to resuming pouring.
- H. Exercise care to prevent splashing of forms or reinforcing with concrete above level of concrete being placed.
- I. Clean reinforcement projecting above or out of concrete immediately after completion of particular unit of pour.
- J. Do not place concrete under adverse weather conditions unless adequate protection is provided. Refer to ACI 301, for weather restrictions and placing temperatures.

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3.8 COLD WEATHER CONCRETING

- A. 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 deg F, 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.
 4. Ensure minimum temperatures are maintained for the duration of the curing period in accordance with ACI 306.1.
 5. Concrete shall be allowed to dry for at least 12 hours before removing temperature protection for water cured or moisture retention cured concrete.

3.9 HOT WEATHER CONCRETING

- A. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. When high temperature, measured on jobsite at concrete placement area, is expected to rise above 90 deg F, maintain concrete temperature below 90 deg F 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. When temperature of reinforcing steel, embeds, subgrade, or forms is greater than 120 degrees F, fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
 3. Protect concrete from wind and direct sunlight to avoid rapid drying.
 4. Apply evaporation retarder to unformed concrete surfaces if the air temperature exceeds 80 degrees F, the wind speed exceeds 10 mph, or the relative humidity is less than 40%. Apply according to manufacturer's written instructions immediately after placing and screeding.
 5. Apply moisture retaining covers or wet cure in accordance with concrete curing and protection methods as specified.

3.10 FINISHING FLOORS AND SLABS

- A. Finish bare concrete floors (adjacent to floors with other surfacing) so concrete surface is level with other finishes, unless otherwise noted.
- B. At areas to receive floor covering, grind joints smooth between slabs on grade and structural slabs and between existing and new surfaces to eliminate unevenness and to provide smooth, level surface across joints.
- C. Wetting the concrete surface during finishing operations is prohibited.
- D. Power floating with troweling machines equipped with normal trowel blades is prohibited.
- E. Protect finished surfaces from damage. Keep free of abrasive materials.

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- F. In areas where water will be present (interior and exterior) place and finish slabs so areas will drain and water will not stand in puddles. Conform to slopes shown. At structural slabs, verify elevations of drains to insure drains will be at low points. Where elevations and slopes are not indicated, generally slope floors 1/8 inch per foot uniformly to drains, unless otherwise directed by Architect.
- G. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot-long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed ¼ inch.
- H. General Finishing Requirements: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces as appropriate to attain slab finish specified.
1. Utilize wet-screed guides, dry-screed guides, and/or edge forms for initial strikeoff set with optical or laser instruments as appropriate to attain specified Floor Profile Number. Check elevation after initial strikeoff and repeat as necessary.
 2. Smooth and restraighen surface using 8 to 10 foot wide bull float, darby, or modified highway straightedge.
 3. Wait until bleed water sheen has disappeared and concrete can sustain finishing operations employed without digging in or disrupting the levelness of the surface.
 4. Float surface with one or more passes using a power float (float shoe blades or pans) or by hand floating if area is small or inaccessible to power driven floats. Restraighen, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
- I. CONC FIN-1: Float Finish.
1. Follow General Finishing Requirements for initial procedures.
- J. CONC FIN-2: Light Trowel Finish.
1. Follow General Finishing Requirements for initial procedures.
 2. Restraighen surface if required following paste-generating float passes using 10-foot wide highway straightedge.
 3. Consolidate concrete surface, uniform in texture and appearance, with one to two passes using power trowel. Hand trowel areas inaccessible by power trowel.
- K. CONC FIN-3: Medium Trowel Finish.
1. Follow General Finishing Requirements for initial procedures.
 2. Restraighen surface if required following paste-generating float passes using 10-foot wide highway straightedge. Apply in two directions at 45 degree angle to strip. Use supplementary material to fill low spots.
 3. Consolidate concrete surface, uniform in texture and appearance, with two to three passes using power trowel. Hand trowel areas inaccessible by power trowel.
- L. CONC FIN-4: Hard Trowel Finish.
1. Follow General Finishing Requirements for initial procedures.
 2. Restraighen surface if required following paste-generating float passes using 10-foot wide highway straightedge. Apply in two directions at 45 degree angle to strip. Use supplementary material to fill low spots.
 3. Consolidate concrete surface, uniform in texture and appearance, with three or more passes using power trowel. Hand trowel areas inaccessible by power trowel.
- M. CONC FIN-8: Broom Finish.

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1. Surfaces of concrete mixes with silica fume and/or calcium nitrite must be kept moist (not wet) during finishing operations to promote proper texturing. Pressure foggers with a reach capable of covering the entire surface can aid finishing operations.
2. Follow General Finishing Requirements, steps 1 through 3, for initial procedures.
3. Scarify surface with a transverse scored texture using a medium bristled broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
4. Finish Tolerance: Surface shall not vary by more than $\pm 1/2$ inch anywhere from elevation noted on Drawings.
5. Finish all concrete slabs to proper elevations to insure that all surface moisture will drain freely, and that no puddles exist. Contractor must bear cost of any corrections to provide positive drainage and repairing poorly finished surface areas.

N. CONC FIN-10: Slip-Resistive Aggregate Finish.

1. Apply at rates recommended by the manufacturer, but not less than 25 pounds per 100 square feet.
2. Verify all procedures noted below are in compliance with manufacturer's written instructions. Notify Architect of any discrepancies requiring resolution.
3. Follow General Finishing Requirements, steps 1 through 3, for initial procedures.
4. Break the surface using a power trowel with float shoes or attached pan.
5. Evenly distribute approximately two-thirds of the specified amount of non-slip aggregate with mechanical spreader.
6. After applied material has absorbed moisture, float surface using hand wooden floats. Take care not to tear through into the underlying concrete.
7. Apply remaining one-third of dry-shake hardener. Tamp aggregate flush with surface, but do not force below surface. Float surface in a like manner.
8. If needed, trowel until the desired surface finish is achieved.
9. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

O. Coordinate final slab texture requirements with Division 9 flooring installer for proper adhesion of final flooring materials.

P. Summary Slab Finish Schedule:

| SLAB USE | SLAB FINISH |
|--|--|
| Fluid-applied or sheet waterproofing; built-up or membrane; sand-bed terrazzo | CONC FIN-1 Float Finish |
| Carpet; raised access floor; or base slabs below acoustic concrete topping slabs | CONC FIN-2 Light Trowel Finish |
| Thin set resilient flooring; paint; or other thin film-finish coating system | CONC FIN-3 Medium Trowel Finish |
| Exposed to view with light foot traffic | CONC FIN-4 Hard Trowel Finish |
| Parking ramps; exterior concrete pavement (Ramp > 7%) | CONC FIN-8 Broom Finish (Rake Finish) |
| Egress stair exposed concrete treads and landings; where shown on Drawings | CONC FIN-10 Slip-Resistive Aggregate Finish |

3.11 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to formed concrete surfaces unless indicated otherwise.
- B. CONC FIN-20: Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces. Before final troweling of exposed treads and landings, apply dampened non-slip shake at a minimum rate of ¼ pound over square foot of surface.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Concrete shall be maintained above 50-degrees F and in a moist condition for at least the first seven days after placement. Provide curing and protection immediately after placement in accordance with ACI 301 using materials as specified herein.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if the air temperature exceeds 80 degrees F, the wind speed exceeds 10 mph, or the relative humidity is less than 40% before and during finishing operations as measured at the Project site. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

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- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Wet Curing: Keep surfaces continuously wet for not less than three days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - d. Protect surface from rapid loss of moisture upon termination of wet curing by covering with moisture-retaining covers for the remainder of the curing period.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- F. Wet cure or use moisture-retaining covers on all concrete surfaces for as long as Hot Weather Concreting conditions persist.
- G. Moisture Condition of Slabs – Following placement of concrete and climatization of building, check to see that any specified tests for moisture emission have been made and a written report submitted prior to floor covering or coating installation.

3.14 JOINT FILLING

- A. Arrange for on-site supervision by manufacturer's personnel.
- B. Coordinate with Owner that adequate protection or spatial separation is provided to ensure there is not contamination of Owner's stored product during joint filling.
- C. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has cured for 30 to 90 days and space has assumed its normal operating temperature. Do not fill joints until construction traffic has permanently ceased.
- D. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry. Clean inside wall of joints to bare concrete.
- E. Mix filler thoroughly with power equipment according to manufacturer's published instructions.
- F. Install semi rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.
- G. Protect joint completely from traffic for 8 hours and from vehicular traffic for 24 hours.
- H. Touch Up:

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1. Within one year after Substantial Completion, touch up joints with additional material and correct for normal joint movement according to manufacturer's published directions.
2. Coordinate schedule for joint touch up with Owner.
3. Touch up joints during Owner's non-working hours as required by Owner.
4. Coordinate with Owner and Architect to ensure there is no contamination of Owner's stored product.

3.15 JOINT SEALING

- A. When concrete has cured 30 to 90 days, and space has assumed its normal operating temperature, rake out loose debris and clean joint with compressed air.
- B. Install backer rod and sealant according to manufacturer's published recommendations.
- C. Protect joint completely from traffic for 24 hours.

3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval and in accordance with ACI 301. Repair methods for defects affecting the concrete's structural performance shall be closely coordinated between Contractor and Engineer.
- B. Patching Mortar: Submit proposed patching materials for Architect's review and approval.
- 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. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 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 slightly higher than 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.

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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 topping. Cut out low areas to ensure a minimum repair topping 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.

3.17 FIELD QUALITY CONTROL

- A. The Owner will engage a qualified testing and inspection agency to provide special inspection and testing services and prepare reports in accordance with Division 01 Section Structural Tests and Special Inspections", and with IBC 2006 Chapter 17 as adopted by the MSBC, and other items which in the professional judgment of the Structural Engineer of Record, are critical to the integrity of the building structure.
- B. Contractor will cooperate with and assist testing agency in obtaining representative concrete samples as concrete is placed for determining slump and air entrainment and casting test cylinders.
1. Provide suitable space on site for storage for field condition test cylinders.
 2. If testing agency is not available, cast compression test cylinders as concrete is placed, determine and record slump of concrete, determine and record air content of concrete and submit cylinders and information to the testing agency.
- C. Inspections:
1. Verification of use of required design mixture.
 2. Concrete placement, including conveying and depositing.
 3. Curing procedures and maintenance of curing temperature.

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4. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests (Technical 1): Testing of composite samples of fresh concrete obtained according to ASTM C 172 - Practice for Sampling Freshly Mixed Concrete, ASTM C 31 - Practice for Making and Curing Concrete Test Specimens in the Field, and ASTM C 39 - Test Method for Compressive Strength of Cylindrical Concrete Specimens. Evaluation and acceptance of concrete shall be in accordance with ACI 318 and according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture where less than 50 yd³ is placed, plus one additional set for each additional 100 yd³ or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of discharge for each composite sample.
 - a. Perform additional tests when concrete consistency appears to change.
 - b. For industrial slabs, slump each truck until slump stabilization is reached then decrease slump frequency to one test per 25 cubic yards.
 3. Air Content: When air content is specified, perform test in accordance with ASTM C 231, pressure method, for normal-weight concrete and ASTM C 173, volumetric method, for structural lightweight concrete.
 - a. Where placement is by pump, air content shall be measured at location of placement.
 - b. For concrete exposed to freezing and thawing, concrete from each truck shall be tested and concrete not meeting specified percentages shall not be placed.
 - c. For interior concrete not exposed to freezing and thawing, such as lightweight concrete on metal decking, perform one test for each set of test cylinders.
 - d. Concrete used in performing air content test shall not be used in fabricating test specimens
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 - b. Cast and field cure one cylinder specimen for each composite sample.
 - 1) Store field-cured cylinders as near as possible to location of concrete represented by sample and give cylinder, insofar as practicable, same protection and curing as adjacent concrete.
 - c. If additional specimens are required to verify early strength of concrete, contractor must pay for additional testing.
 6. Compressive-Strength Tests: ASTM C 39.
 - a. Test one cylinder specimen at 7 days for information, and remaining two cylinder specimens at 28 days for acceptance.
 - b. Deliver field-cured specimens to laboratory at 28 days and test to verify adequacy of curing and protection in field.
 - c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

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3.18 EVALUATION OF TEST RESULTS

- A. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- B. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- C. Test results shall be reported in writing to Architect, concrete supplier, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- E. Additional Tests: Testing and inspecting agency shall make additional tests of concrete at the expense of the Contractor when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- G. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- H. Fill core holes with concrete specified for location.

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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. Precast structural concrete.
- B. Related Sections:
 - 1. Division 01 Section "Structural Tests and Special Inspection" for independent testing agency procedures and administrative requirements.
 - 2. Division 03 Section "Cast-in-Place Concrete" for concrete topping and placing connection anchors in concrete.
 - 3. Division 04 Section "Unit Masonry Assemblies" for inserts or anchorages required for precast concrete slab connections.
 - 4. Division 05 Section "Structural Steel" for furnishing and installing connections attached to structural-steel framing.
 - 5. Division 05 Section "Metal Fabrications" for kickers and other miscellaneous steel shapes.
 - 6. Division 07 Section "Through-Penetration Firestop Systems" for joint-filler materials for fire-resistance-rated construction.
 - 7. Division 07 Section "Joint Sealants" for elastomeric joint sealants and sealant backings.

1.3 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - 2. ACI 306.1 – Standard Specification for Cold Weather Concreting.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.
- B. American Society for Testing and Materials (ASTM).
- C. American Welding Society (AWS):
 - 1. AWS D1.1 - Structural Welding Code - Steel.
 - 2. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
 - 3. AWS C5.4 – Recommended Practices for Stud Welding.
- D. Precast Concrete Institute (PCI):
 - 1. PCI 116 – Quality Control for Plants and Production of Structural Precast and Prestressed Concrete Products.
 - 2. PCI 120 – Design Handbook – Precast and Prestressed Concrete.
 - 3. PCI 135 – Tolerance Manual for Precast and Prestressed Concrete Construction.
- E. The Society for Protective Coatings (SSPC): SSPC Paint 20 - Zinc-Rich Coating.

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1.4 DEFINITION

- A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by Architect.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design precast structural concrete, including comprehensive engineering analysis by a qualified specialty structural engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.
- C. Fire Rating: Design slabs to conform to requirements of IBC and UL for fire rated components.

1.6 SUBMITTALS

- A. Shop Drawings: Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement. Detail fabrication and installation of precast structural concrete units.
 - 1. Indicate joints, reveals, and extent and location of each surface finish.
 - 2. Indicate separate face and backup mixture locations and thicknesses.
 - 3. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
 - 4. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - 5. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 6. Include and locate openings larger than by 10 inches.
 - 7. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
 - 8. Indicate relationship of precast structural concrete units to adjacent materials.
 - 9. Indicate estimated camber for precast floor slabs with concrete toppings.
 - 10. Indicate shim sizes and grouting sequence.
 - 11. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- B. Calculations:
 - 1. Submit design calculations of members and connections to the Architect for review and approval.
 - 2. Include predicted beam, girder and slab deformations at each stage including after erection, after application of dead loads and after long term live and dead loads.
 - 3. Calculations for precast design shall be prepared and signed by qualified specialty structural engineer.
- C. Samples: Submit two 12 inches x 16 inches representative samples of precast concrete wall panels for approval before fabrication.
- D. Certification:
 - 1. Submit to the Architect written certification that precast concrete members comply with the IBC requirements for fire rating.

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1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Participates in PCI's Plant Certification program and is designated a PCI-certified plant as follows:
 - a. Group C, Category C2 - Prestressed Hollow core and Repetitively Produced Products.
- B. Installer Qualifications: A precast concrete erector qualified, as evidenced by PCI's Certificate of Compliance, to erect Category S1 - Simple Structural Systems.
- C. Specialty Structural Engineer Qualifications: Employ Professional Engineer, registered in Minnesota, to perform design of precast structural elements and connections. Sign and seal design Shop Drawings submitted to Owner for review.
- D. Design Standards: Comply with ACI 318 and design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- F. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 - 2. Place adequate dunnage of even thickness between each unit.
 - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that would cause cracking or damage.
- D. Lift and support units only at designated points shown on Shop Drawings.

1.9 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

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1.10 FIELD MEASUREMENTS

- A. Verify actual locations of existing structure, new work previously placed and other construction to which the new work must fit by accurate field measurements before submittal of related shop drawings or fabrication. Show recorded measurements on shop drawings submitted for review. Coordinate fabrication schedule with construction progress to avoid delay of Work. Where work will be connected to existing masonry or concrete, contractor shall engage a testing agency to pre-locate hidden embeds and reinforcing steel prior to submittal of shop drawings. Provide templates and dimensions to fabricator for accurate alignment with existing conditions. Show field conditions impacting the work on the shop drawings, prior to submittal.

PART 2 - PRODUCTS

2.1 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Epoxy-Coated Reinforcing Bars: ASTM A 615, Grade 60, deformed bars, ASTM A 775, epoxy coated.
- C. Epoxy-Coated-Steel Wire: ASTM A 884, Class A coated, plain, flat sheet, Type 1 bendable coating.
- D. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.2 PRESTRESSING TENDONS

- A. Pretensioning Strand: ASTM A 416, Grade 250 or Grade 270, uncoated, 7-wire or ASTM A 886, Grade 270, indented, 7-wire, low-relaxation strand.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- C. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- D. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.4 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36.

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- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- C. High-Strength Bolts and Nuts: ASTM A 325 or ASTM A 490, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436 .
 - 1. Do not zinc coat ASTM A 490 bolts.
- D. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123 or ASTM A 153.
 - 1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
 - 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with SSPC-Paint 20.
- E. Welding Electrodes: Comply with AWS standards.
- F. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.5 BEARING PADS

- A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
 - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi , ASTM D 412.
 - 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test 1 specimen for every 200 pads used in Project.

2.6 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C 1218.

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- D. Normal-Weight Concrete Mixtures: Proportion full-depth mixture by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 116.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.8 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1 and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 - 3. Place reinforcement to maintain at least 3/4-inch minimum coverage. Increase cover requirements according to ACI 318 when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

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4. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses.
- G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
 1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
 5. Protect strand ends and anchorages with a minimum of 1-inch thick, nonmetallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.
- H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
- J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 116.
 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- K. Comply with ACI 306.1 procedures for cold-weather concrete placement.
- L. Comply with PCI MNL 116 procedures for hot-weather concrete placement.
- M. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that will not show in finished structure.
- N. Affix hour rating label of Underwriter's Laboratory to each unit.
- O. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

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- P. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

2.9 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product dimension tolerances.

2.10 COMMERCIAL FINISHES

- A. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.
- B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.
- C. Apply roughened surface finish according to ACI 318 to precast concrete units that will receive concrete topping after installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place, building structural framing has attained minimum allowable design compressive strength or until supporting steel or other structure is complete.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, supports, and bracing as required to maintain position, stability, and alignment of units until permanent connection.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.

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3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 4. Finish erected members neatly and fully with exposed underside free of stains, dirt, blemishes, drips and grout seepage.
 5. For hollow core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.
 6. Fill with joint backer rod and seal underside of exposed joints of precast slabs.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
1. Do not permit connections to disrupt continuity of roof flashing.
- D. Field cutting of precast units is not permitted without approval of the Architect.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable AWS D1.1 and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
 3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
 4. Remove, reweld, or repair incomplete and defective welds.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
- H. Grouting: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled.
1. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces.
 2. Fill joints completely without seepage to other surfaces.
 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
 4. Place grout end cap or dam in voids at ends of hollow core slabs.
 5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
 6. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.

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- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

3.4 FIELD QUALITY CONTROL

- A. See Division 01 Section “Structural Tests and Special Inspections” for testing and inspection requirements.

3.5 REPAIRS

- A. Repair precast structural concrete units if permitted by Architect.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

3.6 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 41 00

**SECTION 03 41 01
PRECAST HOLLOW CORE SLABS**

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. Precast hollow core slabs.
- B. Related Sections:
 - 1. Division 01 Section "Structural Tests and Special Inspection" for independent testing agency procedures and administrative requirements.
 - 2. Division 03 Section "Cast-in-Place Concrete" for concrete topping and placing connection anchors in concrete.
 - 3. Division 04 Section "Unit Masonry Assemblies" for inserts or anchorages required for precast concrete slab connections.
 - 4. Division 05 Section "Structural Steel" for furnishing and installing connections attached to structural-steel framing.
 - 5. Division 05 Section "Metal Fabrications" for kickers and other miscellaneous steel shapes.
 - 6. Division 07 Section "Joint Sealants" for elastomeric joint sealants and sealant backings.

1.3 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - 2. ACI 306.1 – Standard Specification for Cold Weather Concreting.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.
- B. American Society for Testing and Materials (ASTM).
- C. American Welding Society (AWS):
 - 1. AWS D1.1 - Structural Welding Code - Steel.
 - 2. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
 - 3. AWS C5.4 – Recommended Practices for Stud Welding.
- D. International Building Code (IBC).
- E. Precast Concrete Institute (PCI):
 - 1. PCI 116 – Quality Control for Plants and Production of Structural Precast and Prestressed Concrete Products.
 - 2. PCI 120 – Design Handbook – Precast and Prestressed Concrete.
 - 3. PCI 135 – Tolerance Manual for Precast and Prestressed Concrete Construction.
 - 4. PCI TR-6 – Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants.
- F. The Society for Protective Coatings (SSPC): SSPC Paint 20 - Zinc-Rich Coating.

- G. Underwriters Laboratories, Inc. (UL).

1.4 DEFINITION

- A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by Architect.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design precast hollow core slabs, including comprehensive engineering analysis by a qualified specialty structural engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Precast hollow core slabs and connections shall withstand design loads indicated within limits and under conditions indicated.
- C. Fire Rating: Design slabs to conform to requirements of IBC and UL for fire rated components.

1.6 SUBMITTALS

- A. Shop Drawings: Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement. Detail fabrication and installation of precast hollow core slabs.
1. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
 2. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 4. Include and locate openings larger than by 10 inches.
 5. Indicate location of each precast hollow core slab by same identification mark placed on panel.
 6. Indicate relationship of precast hollow core slabs to adjacent materials.
 7. Indicate estimated camber for precast floor slabs with concrete toppings.
 8. Indicate shim sizes and grouting sequence.
 9. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- B. Calculations:
1. Submit design calculations of members and connections to the Architect for review and approval.
 2. Include predicted slab deformations at each stage including after erection, after application of dead loads and after long term live and dead loads.
 3. Calculations for precast design shall be prepared and signed by qualified specialty structural engineer.
- C. Certification:
1. Submit to the Architect written certification that precast concrete members comply with the IBC requirements for fire rating.

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1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Participates in PCI's Plant Certification program and is designated a PCI-certified plant as follows:
 - a. Group C, Category C2 - Prestressed Hollow core and Repetitively Produced Products.
- B. Installer Qualifications: A precast concrete erector qualified, as evidenced by PCI's Certificate of Compliance, to erect Category S1 - Simple Structural Systems.
- C. Specialty Structural Engineer Qualifications: Employ Professional Engineer, registered in Minnesota, to perform design of precast structural elements and connections. Sign and seal design Shop Drawings submitted to Owner for review.
- D. Design Standards: Comply with ACI 318 and design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- F. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 - 2. Place adequate dunnage of even thickness between each unit.
 - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that would cause cracking or damage.
- D. Lift and support units only at designated points shown on Shop Drawings.

1.9 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.10 FIELD MEASUREMENTS

- A. Verify actual locations of existing structure, new work previously placed and other construction to which the new work must fit by accurate field measurements before submittal of related shop drawings or fabrication. Show recorded measurements on shop drawings submitted for review. Coordinate fabrication schedule with construction progress to avoid delay of Work. Where work will be connected to existing masonry or concrete, contractor shall engage a testing agency to pre-locate hidden embeds and reinforcing steel prior to submittal of shop drawings. Provide templates and dimensions to fabricator for accurate alignment with existing conditions. Show field conditions impacting the work on the shop drawings, prior to submittal.

PART 2 - PRODUCTS

2.1 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Epoxy-Coated Reinforcing Bars: ASTM A 615, Grade 60, deformed bars, ASTM A 775, epoxy coated.
- C. Epoxy-Coated-Steel Wire: ASTM A 884, Class A coated, plain, flat sheet, Type 1 bendable coating.
- D. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.2 PRESTRESSING TENDONS

- A. Pretensioning Strand: ASTM A 416, Grade 250 or Grade 270, uncoated, 7-wire or ASTM A 886, Grade 270, indented, 7-wire, low-relaxation strand.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- C. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- D. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.4 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36.

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- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- C. High-Strength Bolts and Nuts: ASTM A 325 or ASTM A 490, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436 .
 - 1. Do not zinc coat ASTM A 490 bolts.
- D. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123 or ASTM A 153.
 - 1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
 - 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with SSPC-Paint 20.
- E. Welding Electrodes: Comply with AWS standards.
- F. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.5 BEARING PADS

- A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
 - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi , ASTM D 412.
 - 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test 1 specimen for every 200 pads used in Project.

2.6 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C 1218.

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- D. Normal-Weight Concrete Mixtures: Proportion full-depth mixture by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 116.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.8 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1 and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.
- D. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 - 3. Place reinforcement to maintain at least 3/4-inch minimum coverage. Increase cover requirements according to ACI 318 when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 - 4. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange,

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space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

- E. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses.
- F. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
 - 1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
 - 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 - 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 - 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
 - 5. Protect strand ends and anchorages with a minimum of 1-inch thick, nonmetallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.
- G. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- H. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast hollow core slabs.
- I. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 116.
 - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- J. Comply with ACI 306.1 procedures for cold-weather concrete placement.
- K. Comply with PCI MNL 116 procedures for hot-weather concrete placement.
- L. Identify pickup points of precast hollow core slabs and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast hollow core slab on a surface that will not show in finished structure.
- M. Affix hour rating label of Underwriters Laboratories, Inc. to each unit.
- N. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace precast hollow core slabs that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

2.9 FABRICATION TOLERANCES

- A. Fabricate precast hollow core slabs straight and true to size and shape so each finished unit complies with PCI MNL 116 product dimension tolerances.

2.10 COMMERCIAL FINISHES

- A. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.
- B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.
- C. Apply roughened surface finish according to ACI 318 to precast concrete units that will receive concrete topping after installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast hollow core slabs until supporting, cast-in-place, building structural framing has attained minimum allowable design compressive strength or until supporting steel or other structure is complete.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast hollow core slabs to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, supports, and bracing as required to maintain position, stability, and alignment of units until permanent connection.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast hollow core slabs are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. Finish erected members neatly and fully with exposed underside free of stains, dirt, blemishes, drips and grout seepage.

5. For hollow core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.
 6. Fill with joint backer rod and seal underside of exposed joints of precast slabs.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
1. Do not permit connections to disrupt continuity of roof flashing.
- D. Field cutting of precast units is not permitted without approval of the Architect.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable AWS D1.1 and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
1. Protect precast hollow core slabs and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil thick coat of galvanized repair paint to galvanized surfaces according to ASTM A780.
 3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
 4. Remove, reweld, or repair incomplete and defective welds.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
- H. Grouting: Grout open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled.
1. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces.
 2. Fill joints completely without seepage to other surfaces.
 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
 4. Place grout end cap or dam in voids at ends of hollow core slabs.
 5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
 6. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

3.4 FIELD QUALITY CONTROL

- A. See Division 01 Section “Structural Tests and Special Inspections” for testing and inspection requirements.

3.5 REPAIRS

- A. Repair precast hollow core slabs if permitted by Architect.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. For exposed to view slab repairs, mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast hollow core slabs that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

3.6 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 41 01

**SECTION 03 45 00
PRECAST ARCHITECTURAL WALL PANELS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulated panels.
- B. Non-insulated panels.
- C. Accessories.

1.2 REFERENCE STANDARDS

- A. Reference the “Latest Edition” of all Standards unless noted otherwise.
- B. ACI – American Concrete Institute International.
- C. ACI 318 – Building Code Requirements for Structural Concrete.
- D. AWS – American Welding Society.
- E. ICC (IBC) – 2006 International Building Code.
- F. PCI – Precast/Prestressed Concrete Institute.
- G. PCI MNL-116 – Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- H. PCI MNL-117 – Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.
- I. PCI MNL-135 – Tolerance Manual for Precast and Prestressed Concrete Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate openings sizes and locations, attachment of related items, and other work related to the fabrication and installation of precast concrete units including the following:
 - 1. Cast-in Electrical Devices: Cast-in Electrical Devices: Coordinate the location of cast-in electrical conduit and junction boxes. Provide panel layout drawings and elevations to Electrical Contractor a minimum of one week prior to casting. Notify Electrical Contractor a minimum of 48 hours prior to casting so they can travel to site, and provide and install electrical items in casting forms.

2. Mechanical and Plumbing Penetrations.

- B. Sequencing: Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.
- C. Preinstallation Meeting: Conduct a preinstallation meeting a minimum of two weeks prior to installation of precast concrete. Require attendance of related trades and the Architect. Review the following items:
 - 1. Review shop drawings and installation details.
 - 2. Anchor and weld plate locations.
 - 3. Opening locations including those cut in the field.
 - 4. Limitations on field cutting and core drilling.
 - 5. Site access requirements and obstructions including but not limited:
 - a. Access roads and maintenance thereof.
 - b. Protection and repair of existing paving.
 - c. Dewatering of footing trenches.
 - d. Job site snow removal.
 - e. Job site debris removal.
 - f. Overhead obstructions including power lines.
 - 6. Cold weather grouting requirements and expectations.
 - 7. Cleaning responsibilities and expectations.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide precast concrete units and connections capable of withstanding design loads within limits and under conditions indicated on Drawings.
 - 1. Loading Requirements: As indicated on the drawings.
 - 2. Fire Resistance Ratings per 2006 International Building Code: As indicated on the drawings.

1.5 SUBMITTALS

- A. See Section 01 3000 – Administrative Requirements; submittal procedures.
- B. Shop Drawings: Include layout plans with unit locations, bearing and top of unit elevations, overall dimensions, building cross sections, wall sections, details, and opening locations.
 - 1. Separately elevate and dimension each type of unit. Indicate location of each unit on overall layout by using the same identification mark placed on the actual unit.
 - 2. Detail head/jamb/sill for each type of cast-in window and door opening including blocking and finish intentions.
 - 3. Indicate all cast-in openings 12 inches or larger in dimension. Label each opening as “cast-in”. Generally note all other non-

- cast-in openings are to be cut in the field by related trades after approval by precaster's engineer.
4. Indicate welded connections by AWS standard symbols and show size, length, and type of each weld.
 5. Indicate locations of and detail hardware and anchorage devices to be cast-in to precast units with relationship to structure.
 6. Indicate locations of and detail hardware and anchorage devices to be embedded into or attached to structure or other construction with relationship to structure.
 7. Schedule loose hardware and anchorage devices to be installed by others; include in schedule: identification marks, item descriptions, and total quantities.
 8. Indicate locations of and detail lifting and handling devices. Use side or edge devices at all locations to minimize unsightly patching at exposed faces. Any face locations must be preapproved by the Architect.
 9. Indicate sections and details showing quantities and position of reinforcing steel and related items including special reinforcement.
 10. Indicate locations of and detail solid concrete and reduced insulation zones. These types of zones are unacceptable unless absolutely necessary and must be preapproved by Owner and Architect prior to fabrication.
 11. Indicate shim sizes and grouting sequence.
 12. Handling procedures, sequence of erection, and bracing plan.
- C. Comprehensive Engineering: Signed and sealed by a professional engineer responsible for its preparation who is registered in the state in which the project is located. Include all dead, live, and other applicable loads used in the design. Indicate loading on shop drawings.
- D. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, notify the Architect immediately and submit design calculations and drawings. Do not adversely affect the appearance, durability or strength of units when modifying details or materials. Maintain the general design concept when altering size of units and alignment.
- E. Samples: Provide Owner/Architect with samples representing the range of finishes and textures when requested. Samples to be a minimum of 12 by 12 by 2 inches in size. Owner/Architect to verify finishes meets or exceeds the expectation of the design intent. Samples are not intended to replace mock-up panels.
- F. Test Reports: At the request of the Owner/Architect provide test reports for concrete and other structural materials tested during fabrication including cement mill reports, mix reports, cylinder break reports.

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1.6 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify recycled material content for recycled content products.
 - b. Certify source for local and regional materials and distance from Project site.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
 - 1. Provide cost data for the following products:
 - a. Products with recycled material content.
 - b. Local and regional products.

1.7 QUALITY ASSURANCE

- A. Single Source Requirement: Provide precast concrete of this section and the following sections by one manufacturer:
 - 1. Section 03 41 00 – Precast Structural Concrete
 - 2. Section 03 41 10 – Precast Double Tees.
 - 3. Section 03 41 13 – Precast Hollow Core Planks.
 - 4. Section 03 46 00 – Precast Non-Architectural Wall Panels.
- B. Designer Qualifications: Precast concrete to be designed under the direct supervision of a Professional Structural Engineer licensed in the state where the project resides.
- C. Fabricator Qualifications: A firm that specializes in manufacturing the types of precast concrete specified in good standing in the PCI Plant Certification Program, and that complies with the following requirements: No Exceptions. No other plant certification will be accepted.
 - 1. Assumes responsibility for engineering precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and Comprehensive Engineering analysis by a qualified Professional Engineer.
 - 2. Participates in PCI's Plant Certification program at the time of bidding and through the construction process.
 - 3. Has sufficient production capacity to produce required units without delaying the Work.
 - 4. Is registered with and approved by authorities having jurisdiction.
- D. Erector Qualifications: PCI Certified, approved by the precast concrete manufacturer, and having a minimum of 5 years experience in the

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erection of precast concrete similar to the requirements of this project. Erector's workman shall be properly trained to handle and erect precast units.

- E. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, "PCI Design Handbook – Precast and Prestressed Concrete," applicable to types of structural precast concrete units indicated.
- F. Quality-Control Standard: For manufacturing procedures and testing requirements and quality control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Concrete Products."
 - 1. Comply with camber and dimensional tolerances of PCI MNL 135, "Tolerance Manual for Precast and Prestressed Concrete Construction."
- G. Welder Qualifications: AWS Certified, approved by the precast concrete manufacturer, and having a minimum of 5 years experience in the erection of precast concrete similar to the requirements of this project. Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel"; and AWS D1.4, "Structural Welding Code – Reinforcing Steel."
- H. Pollution Control Regulations: Comply with all pollution control regulations in fabricating and finishing of all products. Protection of underground water and water runoff is the utmost priority. Capture, treat, and reuse waste water in compliance with local, state, and federal pollution control agencies.
- I. Sustainable Design Requirements:
 - 1. Recycled Content Materials: Furnish materials with recycled content including:

| Material | Minimum Recycled Content (Percent) | |
|----------|------------------------------------|----------------|
| | Post-Consumer | Pre-Consumer |
| Concrete | 20% (post+pre) | up to 1/2 req. |

- 2. Regional Materials: Furnish materials extracted, processed, and manufactured within 250 miles of Project site unless unavailable.

1.8 MOCK-UP

- A. Mock-Up: After samples are approved by Owner/Architect, provide mock-up panels including all interior and exterior finishes and textures, standard opening, insulation configuration, finish and texture transitions, actual scale architectural details, and follow the following procedures:

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1. Invite Owner/Architect to plant at start of the production process.
2. Locate mock-up panel at location determined by the Owner/Architect.
3. Allow for a minimum of three mock-up panels (36 by 48 inches or as directed by Architect) to demonstrate acceptable color range in the final product.
4. Damage a part of an exposed to view surface of each finish, color, and texture, Field repair to determine acceptable patch/repair techniques.
5. Remove and dispose of mock up panel at time determined by the Owner/Architect. Mock-up panel may not remain as part of the Work.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. General Requirement: All lifting and handling, transportation and delivery, storage and support, and erection of precast panels to be performed by qualified personnel using methods and equipment approved by manufacturer.
- B. Identification: Label each unit with date of production and mark indicating unit location on the shop drawings.
- C. Lifting and Handling: Lift and handle units at all times by lifting points indicated on the shop drawings. Lift with manufacturer approved lifting devices. Lifting devices to have a minimum safety factor of 5 to 1.
- D. Transportation and Delivery: Transport units in accordance with manufacturer requirements.
- E. Storage and Support: At all times store and support units off ground with identification marks clearly visible and so lifting devices are accessible and undamaged. Separate stacked units by batten across full width of each bearing point. Do not use stacked precast units for storage of other units or equipment.

1.10 FIELD CONDITIONS

- A. General Contractor shall prepare and maintain site free of obstructions as required by precast erector for the work of this section.
- B. Cold Weather Grouting: Provide written procedures to address cold weather grouting to Owner/Architect prior to the erection process.

1.11 WARRANTY

- A. Provide twelve-month guarantee for workmanship, materials, and satisfactory performance from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Precast Concrete:
 - 1. Wells Concrete Products: www.wellsconcrete.com.
 - 2. Hanson Structural Precast:
www.hansonstructuralprecast.com/midwest/midwest.htm.
 - 3. Substitutions: See Section 01 60 00 – Product Requirements;
including the following requirements:
 - a. Manufacturer and plant must be PCI Certified. No Exceptions.
 - b. Manufacturer must submit product information including typical details, proposed product construction, handling information, solid concrete zone locations, reduced insulation zones, etc. for approval by Architect.
 - c. Manufacturer must obtain written approval of project Architect prior to submitting bid.
 - d. Manufacturer must obtained written approval of General Contractor prior to submitting bid.

2.2 PRECAST UNITS

- A. Insulated Wall Panels (Base Bid):
 - 1. Size/Shape/Profile: As indicated on the drawings.
 - 2. Panel Width: 12'-0" unless noted otherwise.
 - 3. Overall Thickness: 12 inch thick unless noted otherwise; 3 inch exterior wythe, 3 inch insulation, and 6 inch Interior Wythe unless noted otherwise. Thickness may change per design requirements.
 - 4. Form Side Architectural Finish: Smooth Form Grade A Quality Finish.
 - 5. Form Side Architectural Color: 75 % white cement, 25% gray cement, Keystone Limestone aggregate (60%), Waukesha sand (30%), Mason sand (10%)
 - 6. Form Side Non-Architectural Finish: Grade B (PCI), refer to description below.
 - 7. Form Side Non-Architectural Color: Gray.
 - 8. Screed Side Finish: Standard Float (Warehouse Grade), refer to description below.
 - 9. Screed Side Color: Gray.
- B. Insulated Wall Panels (Alternate Bid):
 - 1. Size/Shape/Profile: As indicated on the drawings.
 - 2. Panel Width: 12'-0" unless noted otherwise.
 - 3. Overall Thickness: 12 inch thick unless noted otherwise; 3 inch exterior wythe, 3 inch insulation, and 6 inch Interior Wythe unless noted otherwise. Thickness may change per design requirements.

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4. Form Side Architectural Finish: Acid etch finish, except where indicated by hatch pattern on elevation drawings; hatched area to be sand blast finish.
 1. Form Side Architectural Color: 100% white cement, Keystone Limestone aggregate (60%), Kraemer sand (30%), Mason sand (10%).
 2. Form Side Non-Architectural Finish: Grade B (PCI), refer to description below.
 3. Form Side Non-Architectural Color: Gray.
 4. Screed Side Finish: Standard Float (Warehouse Grade), refer to description below.
 5. Screed Side Color: Gray.
- C. Non-Insulated Wall Panels (Interior Bearing Walls):
1. Size/Shape/Profile: As indicated on the drawings.
 2. Panel Width: 12'-0" unless noted otherwise.
 3. Overall Thickness: 10 inches thick unless noted otherwise.
 4. Form Side Architectural Finish: Standard Grade (PCI), refer to description below.
 5. Form Side Color: Gray.
 6. Form Side Non-Architectural Finish: Standard Grade (PCI), refer to description below.
 7. Form Side Non-Architectural Color: Gray.
 8. Screed Side Finish: Standard Float (Warehouse Grade), refer to description below.
 9. Screed Side Color: Gray.
- D. Non-Insulated Wall Panels (Base Bid – Exterior Walls):
1. Size/Shape/Profile: As indicated on the drawings.
 2. Panel Width: 12'-0" unless noted otherwise.
 3. Overall Thickness: 10 inches thick unless noted otherwise.
 4. Form Side Architectural Finish: Smooth Form Grade A Quality Finish.
 5. Form Side Color: 75 % white cement, 25% gray cement, Keystone Limestone aggregate (60%), Waukesha sand (30%), Mason sand (10%)
 6. Form Side Non-Architectural Finish: Grade B (PCI), refer to description below.
 7. Form Side Non-Architectural Color: Gray.
 8. Screed Side Finish: Standard Float (Warehouse Grade), refer to description below.
 9. Screed Side Color: Gray.
- E. Non-Insulated Wall Panels (Alternate Bid – Exterior Walls):
1. Size/Shape/Profile: As indicated on the drawings.
 2. Panel Width: 12'-0" unless noted otherwise.
 3. Overall Thickness: 10 inches thick unless noted otherwise.

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4. Form Side Architectural Finish: Acid etch finish, except where indicated by hatch pattern on elevation drawings; hatched area to be sand blast finish.
 1. Form Side Color: 100% white cement, Keystone Limestone aggregate (60%), Kraemer sand (30%), Mason sand (10%).
 2. Form Side Non-Architectural Finish: Grade B (PCI), refer to description below.
 3. Form Side Non-Architectural Color: Gray.
 4. Screed Side Finish: Standard Float (Warehouse Grade), refer to description below.
 5. Screed Side Color: Gray.
- F. Form Side "Architectural Finish Type" Descriptions:
1. Cast on Steel Forms:
 - a. Smooth, Grade B (PCI).
 2. Exposed Aggregate Finish Types: Pattern and finish locations as indicated on the drawings.
 - a. Acid-Etched finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces to match accepted sample or mockup units. Protect hardware, connections, and insulation from acid attack.
 3. Reveals: As indicated on the drawings; maximum 1/2 inch deep for 3 inch thick exterior concrete wythe.
 4. Form Liners with Textured-Surface finish: Impart texture by form liners or inserts, to match accepted sample or mockup units for acceptable surface air voids, sand streaks, and honeycombs, with uniform color and texture.
- G. Form Side Non-Architectural Finishes "By PCI":
1. Commercial Grade (PCI): This is essentially an "as-cast" finish. Concrete may be produced in forms that impart a texture to the concrete, (e.g. plywood lumber or steel forms with offset joints, dents, or holes). The surface may contain air holes (bug holes) and water marks, and there may be some minor chips and spalls. There may be patches and streaks of color variation within the surface, and the overall color tone may vary between pieces.

Large fins from joint bleeding should be removed, but mall fins may remain. Only "honeycombed" and/or badly spalled areas should be repaired or finished. All faces should have true, well-defined surfaces. The maximum allowable form joint offset should be limited to 3/16 inch.
 2. Standard Grade (PCI): Small surface holes caused by air bubbles ("bug holes"), normal color variations, normal form joint marks and minor chips and spalls should be considered acceptable.

No air holes (bug holes) larger than 1/2 inch in any direction

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should be permitted. Air holes between 1/4 and 3/8 inch in width that occur in high concentration (more than one per 2 square feet) should be filled. Large, unsightly surface blemishes or honeycombing should be repaired. The maximum allowable form joint offset should be limited to 1/8 inch. This finish may be used where products are exposed to view but the function of the structure does not require a special finish. The surface should be suitable for an applied textured coating but not necessarily suitable for painting.

This is the typical finish grade for all structural units unless noted otherwise.

3. Grade B (PCI): All air holes over 1/4 inch in size should be filled. Air holes between 1/8 and 1/4 inch in width that occur in high concentration (more than one per 2 square inches) should be filled. Surface blemishes due to holes or dents in form should be repaired. Discoloration should be permitted at form joints.
4. Grade A (PCI): All formed finishes of structural components shall be considered Grade A resulting from the process of power washing all formed surfaces to expose latent pinholes, then rubbing the surfaces with a cement paste to fill in all pinholes.

Discoloration should be allowed at form joints. All form joints should be ground smooth.

This surface is suitable for painting (especially with a textured or "sand" paint). However, some surface blemishes will be visible. All air pockets and holes over 1/4 inch in diameter shall be filled with a sand-cement paste. All form offsets or fins over 1/8 inch shall be ground smooth.

- H. Screed Side Non-Architectural Finishes "By Description":
 1. Standard Float (Warehouse Grade): Screed or float finish uniformed surfaces: Strike off and consolidate concrete with vibrating screeds to a uniform finish, float finish, if required. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. No major imperfections, honeycombing, or defects are permitted.

2.3 MATERIALS

- A. All materials shall comply with the specifications, standards and codes quoted herein. The Architect/Engineer upon request shall be furnished satisfactory certification that all material incorporated in the precast concrete products comply with the requirements herein specified.
- B. Forms: Material that will provide smooth/anticipated finish that meets the expectations of the Owner/Architect.

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- C. Form Release Agent: Non-staining type that will not impair anticipated finishes of the Owner/Architect and that will not inhibit field installed coatings, sealants, and adhesives.
- D. Portland Cement: ASTM C150 - Type I or III: ASTM C150.
 - 1. Mix materials are as follows:
 - a. Gray cement.
 - b. White cement.
 - c. Combination of gray/white cement; Match sample at Architects office.
 - d. Integral Color; Match sample at Architects office.
- E. Admixtures:
 - 1. Air entraining admixtures: ASTM C260.
 - 2. Water reducing, retarding, accelerating admixtures: ASTM C494.
- F. Aggregates: ASTM C33 except that coarse aggregates for precast concrete surfaces exposed to damp conditions shall contain zero iron oxides.
 - 1. See approved samples for coarse and fine aggregates.
 - 2. Light weight aggregate structural components: ASTM C330.
- G. Water: Potable or free from foreign materials in amounts harmful to concrete and embedded steel.
- H. Reinforcing Steel: Reinforcing steel or mesh will be selected from the following materials to conform to precaster's design unless otherwise indicated on the drawings. Reinforcing bars shall not be welded without specific approval of Architect/Engineer.
 - 1. Bars:
 - a. Deformed billet steel: ASTM A615.
 - b. Deformed rail steel: ASTM A616.
 - c. Deformed axle steel: ASTM A617.
 - d. Deformed low-alloy steel: ASTM A706.
 - 2. Wire: Cold drawn steel: ASTM A82.
 - 3. Wire fabric:
 - a. Welded steel: ASTM A 185.
 - b. Welded deformed steel: ASTM A497.
- I. Strand: Uncoated, 7-wire, Stress-Relieved Strand: ASTM A416-Grade 250K or 270K.
- J. Anchors and Inserts:
 - 1. Materials:
 - a. Structural Steel: ASTM A36.
 - b. Shop Primer: Manufacturer's standards.
 - 1) Location: Items protected by sealants or finish coatings.
 - c. Hot Dipped Galvanized: ASTM A153.

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- 1) Location: Items left exposed unless otherwise indicated. Cold galvanize field welds.
 - d. Zinc-rich Coating: MIL-P-2135, self-curing, one component, sacrificial.
 - 1) Location: As indicated.
 - e. Cadmium Coating (Electroplated).
 - 1) Location: As indicated.
 - f. Stainless Steel: ASTM A666, type 304.
 - g. Location: As indicated.
- K. Sandwich Panel Insulation:
 - 1. Expanded Polystyrene (Neopor Brand) Insulation:
 - a. 1.25 pound density board (R-4.83/in. at 40°).]
 - 2. All panels are to be insulated unless indicated otherwise on the drawings.
- L. Wythe connectors: Maximum connector size to be 12 gauge stainless steel pin to adequately tie the two wythe together. Consult precaster for thermal transfer analysis.
- M. Other Items Cast-In to Precast Units:
 - 1. Items: As indicated on the drawings.
 - 2. Locations: As indicated on the drawings.

2.4 ACCESSORIES

- A. Cement Grout: Type I (ASTM C150 / C150M), “Dry Pack”, portland cement, sand and water having a minimum of 3,000 psi compressive strength at 28 days. (Approximately 3 to 1 sand/cement ratio.) Use “Cement Grout” unless “Non-Shrink Cement Grout” is specifically indicated by precast or structural engineer.
- B. Non-Shrink Cement Grout: Per ASTM C1107/C1107M, Type III (ASTM C150 / C150M), “Dry Pack”, portland cement, sand, and water having a minimum of 10,000 psi compressive strength at 28 days.
- C. Bearing Pads:
 - 1. Unless noted otherwise on the plans, Elastomeric Bearing Pads conforming to Division 2, Section 25 of AASHTO Standard Specifications for Highway Bridges shall be used.
 - 2. The PCI Design Handbook, Second Edition, Part 5.1 through Part 5.5 shall be used for the design of bearing pads.
 - 3. Teraflouroethylene (TFE) reinforced with glass fibers and applied to stainless or structural steel plates.
- D. Welding Materials: Per AWS D1.1/D1.1M, “Structural Welding Code – Steel”; compatible with materials being welded.

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- E. Welded Studs: Per AWS D1.1/D1.1M, "Structural Welding Code – Steel"; compatible with materials being welded.
- F. Anchor Bolts: As designed by precast manufacturer, cast-in place by others.
- G. Attachment Plates: As designed by precast manufacturer, cast-in place by others.
- H. Other Load Bearing Loose Steel Items: As designed by precast manufacturer.

2.5 FABRICATION

- A. Cast all wall panels with architectural finish face down.
- B. Pre-stress each wythe of flat panel. No Exceptions.
- C. Achieve final architectural finishes only by techniques specified within this specifications section. (Form Side Architectural Finishes "By Description".)
- D. Cast-in preservative treated 2x wood blocking at perimeter of window and man door openings. Wood nailers shall provide adequate backing for installation of window and door units. Return face finish to edge of blocking/insulation.
- E. Cast solid concrete edges at the perimeter of sectional/overhead door type openings unless noted otherwise; 2 inch thick minimum. Return face finish to interior side of panel.
- F. Cast-in bent steel plates at perimeter of sectional/overhead door type openings for attachment of door hardware. Continuously weld splices and grind smooth to a point that they are capable of being concealed by field painting.
- G. All reinforcing steel shall have minimum cover as required by code and shall be accurately located as indicated on the approved shop drawings. Metal chairs, with or without coatings, shall not be permitted in the finished face.
- H. Composite design acceptable when approved by architect/engineer.
- I. All of the fabrication procedures shall be carried out under a fully protective overhead and sidewall covering, with a constant temperature of between 50 to 80 F being maintained except during the curing cycle.

2.6 FABRICATION TOLERANCES

- A. Fabricate units in accordance with MNL-116, MNL-117, MNL-135 and as follows:
 - 1. Length: Plus or minus 1/8 inch for every 10 feet in length or 1/2 inch, whichever is greater.
 - 2. Width: Plus or minus 1/8 inch for items 48 inch or less; 1/4 inch for items 48 to 120 inches, and 1/2 inches maximum for items over 120 inches and more.
 - 3. Cross Sectional Dimensions: Plus or minus 1/8 inch for items 48 inch or less; 1/4 inch for items 48 to 120 inches, and 1/2 inches maximum for items over 120 inches and more.
 - 4. Cast-in Anchors and Inserts: Plus or minus 1 inch from centerline location indicated on shop drawings. (Consult with precaster for tighter tolerances)
 - 5. Horizontal Alignment (Sweep): Plus or minus 1/3 inch for every 10 feet in length or 1/2 inch, whichever is greater.
 - 6. Vertical Alignment (End Squareness): Plus or minus 1/8 inch for every 12 inches in height or 1/4 inch, whichever is greater.
 - 7. Bowing (Camber): Variation between units is plus or minus 1/4 inch for every 10 feet in length or 1/2 inch, whichever is greater.
 - 8. Blockouts: Plus or minus 1 inch from centerline location indicated on shop drawings.

2.7 CONCRETE MIXES

- A. 28-day compressive strength: Minimum of 5,000 psi.
- B. Use of calcium chloride, chloride ions or other salts is not permitted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site is free of obstructions and ready to receive the work. Obstructions include but are not limited to dewatering of footing trenches, jobsite snow removal, site debris, overhead obstructions, including power lines.
- B. Verify access roads have been prepared to handle all weather conditions and are acceptable to precast concrete installer.
- C. Do not begin the work of this section unless preparations by the site contractor are complete and the site contractor understands and agrees to maintain acceptable conditions until precast installation is complete. Beginning the work of this section is acceptance of existing conditions.

3.2 PREPARATION

- A. Preparation: General Contractor (Buyer) shall be responsible for the following items:
 - 1. Removal of all obstructions including but not limited to power lines and wires that may be hazardous to precaster's personnel and other items required for precast installation.
 - 2. All-weather access roads for precaster's trucks and cranes. Refer to precaster's proposal/quotation for more defined access requirements.
 - 3. Grid locations, building corners, finish floor elevations, top of door elevations and other survey points/lines/elevations for accurate installation of precast units.
 - 4. True and level bearing surfaces on all field placed bearing walls and other field placed supporting units.
 - 5. Placement and accurate alignment of anchor bolts, plates, or dowels in column footings, grade beams, and other field placed supporting units.
 - 6. All shoring required for composite beams and slabs. Shoring shall have a minimum load factor of 1.5 x (dead load plus construction loads).
 - 7. Repair all concrete and bituminous surfaces damaged during precast installation. Examine surfaces with precaster before and after precast installation and coordinate efforts to minimize damage.

3.3 ERECTION

- A. Precast Unit Curing Procedures: Contact precaster for minimum curing requirements.
- B. Erection Shall Be Defined As:
 - 1. Placing, aligning, and leveling the precast units in final positions in the structure on the designated supporting surfaces.
 - 2. Connection of precast units to each other, or to supporting structural units as indicated on the shop drawings.
 - 3. Removal of lifting hooks, if necessary.
 - 4. Cleaning and sealing of "Precast" to "Precast" joints. Joints include:
 - a. Precast to precast including joints between interior and exterior units.
 - b. Precast to bearing.
 - 5. Sealing of "Precast" to "Other Materials" and joints that require "Firestopping" are NOT considered part of erection unless indicated otherwise.
 - 6. Field repair and cleaning of architecturally finished surfaces, refer to "Field Repair and Cleaning of Precast Units" at end of section.

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- C. Field Welding: Complete field welding using qualified personnel, equipment, and welding materials that are compatible to the base material.
- D. Grouting:
 - 1. Pack grout between bottom of precast walls and their bearing surfaces filling the entire area free of voids. Rake joints back at locations where backer rod and sealant is to be installed.
 - 2. General Contractor Responsibility: General Contractor shall be responsible for providing “shelters/tarps” and “temp heat” for grouting when temperatures are below 40 degrees for a 24 hour period.

3.4 TOLERANCES

- A. Erect precast units level, plumb, square, true, and in alignment without exceeding the non-cumulative erection tolerances of PCI MNL 135. Position units so that dimensional errors do not accumulate and so joints remain aligned and uniform as erection progresses. Level out variations between adjacent units by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the Architect/Engineer.
- B. In the event that precast units cannot be adjusted to conform to design or tolerance criteria, cease work and advise Architect. Execute modifications as directed by the Architect prior to resuming work.

3.5 SEALANT INSTALLATION

- A. General Contractor/Owner shall coordinate with the precast erector sealing of precast joints where required. The general contractor accepts responsibility if the precast joints above the roof deck and below grade are not sealed due to poor coordination/site conditions. The precast erector shall accept responsibility if precast joints are not sealed but were coordinated in a timely fashion by the General Contractor/Owner.
- B. Install backer rod and sealant according to product manufacturer's instructions.

3.6 FIELD REPAIR AND CLEANING OF PRECAST UNITS

- A. Repairs by Precast Erector: Repair chipping, spalling, cracking, and other damages to precast units after delivery to the jobsite in accordance with procedures of PCI Erectors Manual. After installation and repairs are completed, all additional damage is the responsibility of, and at the cost of, the General Contractor. Consult with precaster for repairs of structural precast units.

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- B. Cleaning by General Contractor: Clean exposed surfaces (not cleaned by precaster) that are soiled during shipping, installation, and remaining construction operations, prior to Substantial Completion. Clean in accordance with precast manufacturer's recommendations.

3.7 CLEANING BY PRECAST ERECTOR:

- A. Protect adjacent work, buildings, and landscaping from damage caused by cleaning.
- B. Schedule washing and cleaning procedures accordingly to minimize the number of trips to site. Washing and cleaning shall be completed at "one time", unless other trips are required to complete the work. After cleaning is completed, all additional cleaning is the responsibility of, and at the cost of, the General Contractor.
- C. Exterior Architectural Finishes: Wash and clean architectural finishes to remove road film, effloresces, and to even out color variations from panel to panel. Precast units shall be cleaned only after all installation procedures, including joint treatment, are completed. Perform cleaning and rinsing procedures in accordance with the precast manufacturer's recommendations.
- D. Interior Face of Architecturally Finished Panels: Washing and cleaning is NOT part of the work covered by Precaster. "Color Streaking" will be evident on the backside/interior of architecturally finished panels.

3.8 INSPECTION AND ACCEPTANCE

- A. Final inspection and acceptance of erected precast/prestressed concrete shall be made by Architect/Engineer to verify conformance with plans and specifications.

3.9 PROTECTION

- A. General Contractor to protect precast units from remaining construction operations.

END OF SECTION

**SECTION 04 05 13
MASONRY MORTARING**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Preblended mortar mixes

1.2 REFERENCES

- A. ASTM International:
1. ASTM C91 Standard Specification for Masonry Cement.
 2. ASTM C144 Standard Specification for Aggregate for Masonry Mortar.
 3. ASTM C150 Standard Specification for Portland Cement.
 4. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes.
 5. ASTM C270 Standard Specification for Mortar for Unit Masonry.
 6. ASTM C476 Standard Specification for Grout for Masonry.
 7. ASTM C780 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 8. ASTM C979 Standard Specification for Pigments for Integrally Colored Concrete.
 9. ASTM C1329 Standard Specification for Mortar Cement.
 10. ASTM C1384 Standard Specification for Admixtures for Masonry Mortars.
 11. ASTM E514 Standard Test Method for Water Penetration and Leakage Through Masonry.
- B. International Masonry Industry All-Weather Council (IMIAC):
1. Recommended Practices and Guide Specification for Cold Weather Masonry Construction.
 2. Recommended Practices and Guide Specification for Hot Weather Masonry Construction.
- C. National Concrete Masonry Association (NCMA):
1. NCMA TEK Bulletin #8-2A Removal of Stains from Concrete Masonry.
 2. NCMA TEK Bulletin #8-3A Control and Removal of Efflorescence.

1.3 SYSTEM DESCRIPTION

- A. Design and Performance Requirements: Provide mortar mixes which have been selected, manufactured, mixed and installed to comply with the following:

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1. ASTM C270.
2. ASTM C780.

1.4 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures Section.
- B. Product Data: Submit manufacturer's product data.
- C. Quality Assurance/Control Submittals: Submit the following:
 1. Certificates: Submit manufacturer's certificate that products meet or exceed specified requirements.

1.5 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 1. Materials Resources Certificates:
 - a. Certify recycled material content for recycled content products.
 - b. Certify source for local and regional materials and distance from Project site.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
 1. Provide cost data for the following products:
 - a. Products with recycled material content.
 - b. Local and regional products.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity.
- B. Sustainable Design Requirements:
 1. Recycled Content Materials: Furnish materials with recycled content including pre-consumer and post-consumer content.
 2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site when possible.

1.7 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 01 Product Requirement Section.

- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection:
 - 1. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
 - 2. Store materials in a dry location, covered with a tarp or other suitable covering.

1.8 PROJECT/SITE CONDITIONS

- A. Environmental Requirements:
 - 1. Do not build or apply mortar products on frozen substrates.
 - a. Remove and replace unit masonry damaged by frost or by freezing conditions.
 - 2. Take special care when constructing in extremely hot or cold weather. Comply with the following standards:
 - a. IMIAC Recommended Practices and Guide Specification for Cold Weather Masonry Construction.
 - b. IMIAC Recommended Practices and Guide Specification for Hot Weather Masonry Construction.

PART 2 PRODUCTS

2.1 PREBLENDED MORTAR MIXES

- A. Manufacturer: SPEC MIX, Inc.
 - 1. Contact: 2025 Centre Pointe Blvd., Suite 150, Mendota Heights, MN 55120; Telephone: (888) 773-2649, (651) 688-8966; Fax: (888) 329-7732; E-mail: info@specmix.com; website: www.specmix.com.
- B. Proprietary Products/Systems: Dry, preblended mortar mixes, including the following:
 - 1. SPEC MIX Pre-Blended Mortar Mix:
 - a. Material: Preblended factory mix of Portland cement and hydrated lime or masonry cement or mortar cement and sand aggregate mixtures.
 - b. Mortar Type: Property Mixture Type M Below Grade and Type S Above Grade.
 - c. Aggregate Type: Fine.
 - d. Material Standard for Aggregate: Comply with ASTM C144.
 - e. Material Standard for Portland Cement: Comply with ASTM C150.
 - f. Material Standard for Hydrated Lime: Comply with ASTM C207.

- g. Material Standard for Masonry Cement: Comply with ASTM C91.
- h. Material Standard for Mortar: Comply with ASTM C270.
- i. Material Standard for Masonry Grout: Comply with ASTM C476.
- j. Material Standard for Mortar Cement: Comply with ASTM C1329.

2.2 PRODUCT SUBSTITUTIONS

- A. Substitutions: In accordance with Section 01 60 00.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the mortar manufacturer.
- B. SPEC MIX Pre-Blended Standard Mortar Mix:
 - 1. Fill head and bed joints for full thickness of the face shells to provide the greatest resistance to water penetration.
 - 2. Tooling:
 - a. Tool the mortar joints concave or to a V-profile to provide the greatest resistance to water penetration. Do not use raked, flush, extruded, struck, beaded, weathered or other joint profiles due to their reduced water resistance.
 - b. Tool the mortar joints when they are thumbprint hard to provide the greatest resistance to water penetration and to help minimize hairline cracks between the mortar and the CMU.
 - 3. Cover the top of unfinished masonry work to protect it from the weather and to prevent accumulation of water in the cores of the CMU.
 - 4. Cleaning:
 - a. Remove primary efflorescence from masonry walls exposed in the finished work in accordance with manufacturer's recommendations and NCMA TEK Bulletin #8-3A.
 - b. Remove dirt or stains from masonry walls exposed in the finished work in accordance with the manufacturer's recommendations and NCMA TEK Bulletin #8-2A.
 - c. Promptly remove excess wet mortar containing integral water repellent mortar admixture from the face of the masonry as work progresses. Do not use strong acids, overaggressive sandblasting or high pressure cleaning methods.

- d. Comply with applicable environmental laws and restrictions.

3.2 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Verify that site conditions are acceptable for use of mortar mixes.
 - 2. Do not proceed with use of mortar mixes until unacceptable conditions are corrected.

3.3 CONSTRUCTION

- A. Mix mortar using a mechanical mortar mixer to ensure homogeneity and workability. Hand mixing of the mortar is permitted only with written approval of the Architect who will outline hand-mixing procedures.
 - 1. Observe mixing times of 4 - 5 minutes, consistent from batch to batch.
- B. Use clean, potable water; add the maximum amount consistent with optimum workability.
 - 1. Maintain a uniform water/cement ratio.
 - 2. At the end of the day, thoroughly rinse the mixer to avoid contamination of future mortar batches.
- C. Retemper mortar by adding additional mixing water only to replace water lost due to evaporation.
- D. Discard mortar 2.5 hours after initial mixing.
- E. Tool mortar joints when surface is thumbprint hard.
 - 1. Keep tooling time consistent.
 - 2. Do not strike joint too early or too late in order to maintain color consistency.
- F. Cure mortar a minimum of 28 days.
- G. For masonry core fill grout applications, comply with the requirements of ASTM C476.

3.4 CLEANING

- A. Cleaning Method:
 - 1. Clean masonry with the least aggressive cleaning solution and technique possible.
 - 2. Comply with cleaning procedure and recommendations of the manufacturers of both the cleaning solution and the unit masonry.
 - 3. Utilize the same cleaning procedure on the sample panel at selection and during construction.

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3.5 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on the site.

END OF SECTION

SECTION 04 05 16

MASONRY GROUTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grout for masonry.

1.2 REFERENCES

- A. ACI 530 - Building Code Requirements for Masonry Structures.
- B. ACI 530.1 - Specifications For Masonry Structures.
- C. ASTM C94 - Ready-Mixed Concrete.
- D. ASTM C150 - Portland Cement.
- E. ASTM C404 - Aggregates for Masonry Grout.
- F. ASTM C476 - Grout for Masonry.
- G. ASTM C1019 - Method of Sampling and Testing Grout.
- H. IMIAC (International Masonry Industry All-Weather Council) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
- I. IMIAC (International Masonry Industry All-Weather Council) - Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify recycled material content for recycled content products.
 - b. Certify source for local and regional materials and distance from Project site.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
 - 1. Provide cost data for the following products:
 - a. Products with recycled material content.
 - b. Local and regional products.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 and ACI 530.1.
- B. Sustainable Design Requirements:
 - 1. Recycled Content Materials: Furnish materials with recycled content including pre-consumer and post-consumer content when possible.
 - 2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site when possible.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00.
- B. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
- B. Hot Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cementitious materials:
 - 1. Portland Cement: ASTM C 150.
 - 2. Hydrated Lime: ASTM C207, Type S.
- B. Aggregates:
 - 1. Fine aggregate: ASTM C 404.
 - 2. Coarse aggregate: ASTM C 404.
- C. Water: Clean and potable.

2.2 GROUT MIXES

- A. Bond Beams: 3,000 psi strength at 28 days; 8-10 inches slump; mixed in accordance with ASTM C476 Course grout.
- B. Engineered Masonry: 3,000 psi strength at 28 days; 8-10 inches slump; mixed in accordance with ASTM C476 Fine grout.

2.3 GROUT MIXING

- A. Mix grout in accordance with ASTM C94.
- B. Do not use anti-freeze compounds to lower the freezing point of grout.

2.4 MIX TESTS

- A. Test mortar and grout in accordance with Section 01 40 00.
- B. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Request inspection of spaces to be grouted.

3.2 PREPARATION

- A. Apply bonding agent to existing surfaces.
- B. Plug clean-out holes with masonry units. Brace masonry for wet grout pressure.

3.3 FIELD GROUT MIXING

- A. Control batching procedure to ensure proper proportions by measuring materials by volume.

3.4 INSTALLATION

- A. Install grout in accordance with ACI 530.1/ASCE.6 and the requirements of the specific masonry section.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.
- D. Do not displace reinforcement while placing grout.
- E. Remove excess mortar from grout spaces.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 40 00.
- B. Test and evaluate grout in accordance with ASTM C1019.

END OF SECTION

SECTION 04 05 19

MASONRY ANCHORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes anchors and ties for masonry wall systems.

1.2 REFERENCES

- A. ASTM A153 - Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data in accordance with Section 01 33 00 - Submittals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading: In accordance with Section 01 60 00 - Material and Equipment.
- B. Acceptance at Site: In accordance with Section 01 60 00 - Material and Equipment.
- C. Storage and Protection: In accordance with Section 01 60 00 - Material and Equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Dur-O-Wal, Inc., 3115 N. Wilke Road, Suite A, Arlington Heights, IL 60004.
- B. Other acceptable manufacturers offering equivalent products:
 - 1. AA Wire Products Company, 6100 New England Ave., Chicago, IL 60638
 - 2. Heckmann Building Products Inc., 4015 W. Carroll Ave., Chicago, IL 60624.
 - 3. Hohmann & Barnard, Inc. 30 Rason Court, PO Box 5270, Hauppauge, NY 11788.
 - 4. Wire-Bond, PO Box 240988, 400 Roundtree Road, Charlotte, NC 28224.

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- C. Substitutions: Under the provisions of Section 01 60 00.

2.2 COMPONENTS

- A. Veneer Anchoring Systems - Masonry Backup: #D/A 5213 as manufactured by Dur-O-Wal, Inc., hot dip galvanized in accordance with ASTM A 153.
- B. Veneer Anchoring Systems - Steel Stud Backup: #D/A 213 with # D/A 807 standard veneer screw, as manufactured by Dur-O-Wal, Inc., hot dip galvanized in accordance with ASTM A 153.
- C. Dovetail Slots and Anchors: #D/A 100 slots with #D/A 720-724 anchors as manufactured by Dur-O-Wal, Inc., hot dip galvanized in accordance with ASTM A 153.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the masonry section referencing this section.

END OF SECTION

SECTION 04 05 20

JOINT REINFORCEMENT and Bars

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes horizontal joint reinforcement and vertical reinforcement bars for masonry wall systems.

1.2 REFERENCES

- A. ASTM A153 - Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- B. ASTM A 615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data in accordance with Section 01330 - Submittals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading: In accordance with Section 01600 - Material and Equipment.
- B. Acceptance at Site: In accordance with Section 01600- Material and Equipment.
- C. Storage and Protection: In accordance with Section 01600 - Material and Equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Dur-O-Wal, Inc., 3115 N. Wilke Road, Suite A, Arlington Heights, IL 60004.
- B. Other acceptable manufacturers offering equivalent products:
 - 1. AA Wire Products Company, 6100 New England Ave., Chicago, IL 60638
 - 2. Heckmann Building Products Inc., 4015 W. Carroll Ave., Chicago, IL 60624.

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3. Hohmann & Barnard, Inc. 30 Rason Court, PO Box 5270, Hauppauge, NY 11788.
4. Wire-Bond, PO Box 240988, 400 Roundtree Road, Charlotte, NC 28224.

C. Substitutions: Under the provisions of Section 01600.

2.2 COMPONENTS

- A. Horizontal Joint Reinforcement:
 1. Multiwythe Wall Systems: #D/A 370 Dur-O-Eye as manufactured by Dur-O-Wal, Inc., hot dipped galvanized in accordance with ASTM A 153.
 2. Singlewythe Wall Systems: #D/A 3100 Truss as manufactured by Dur-O-Wal, Inc., hot dipped galvanized in accordance with ASTM A 153.
- B. Vertical Reinforcement: Billet steel deformed bars in accordance with ASTM A 615, Grade 60.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the masonry section referencing this section.

END OF SECTION

**SECTION 04 22 00
CONCRETE UNIT MASONRY**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete masonry units.
- B. Reinforcement, anchorage, and accessories.

1.2 REFERENCES

- A. ACI 530 - Building Code Requirements for Masonry Structures.
- B. ACI 530.1 - Specifications For Masonry Structures.
- C. ASTM C90 - Load-Bearing Concrete Masonry Units.
- D. ASTM C129 - Non-Load Bearing Concrete Masonry Units.
- E. IMIAC - International Masonry Industry All-Weather Council:
Recommended Practices and Guide Specification for Cold Weather
Masonry Construction.
- F. UL - Fire Resistance Directory.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify source and origin for [salvaged] [and] [reused] products.
 - b. Certify recycled material content for recycled content products.

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**SECTION 04 22 00 – CONCRETE
UNIT MASONRY**

- c. Certify source for local and regional materials and distance from Project site.
 - d. Certify lumber is harvested from Forest Stewardship Council Certified well managed forest.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
 - 1. Provide cost data for the following products:
 - a. Products with recycled material content.
 - b. Local and regional products.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 and ACI 530.1.
- B. Sustainable Design Requirements:
 - 1. Recycled Content Materials: Furnish materials with recycled content including pre-consumer and post-consumer content whenever possible.
 - 2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site when possible.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire rated masonry construction.

1.8 PRE-INSTALLATION CONFERENCE

- A. Convene one week prior to commencing work of this section, under provisions of Section 01 30 00.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.
- B. Store concrete masonry off ground to prevent contamination by mud, dust or materials likely to cause staining or other defects.
- C. Cover materials when necessary to protect from elements.
- D. Protect reinforcement from elements.

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1.10 JOB CONDITIONS

- A. Protection of Work:
 - 1. Wallcovering:
 - a. During erection, cover top of wall with strong waterproof membrane at end of each day or shutdown.
 - b. Cover partially completed walls when work is not in progress.
 - c. Extend cover minimum of 24 inch down both sides.
 - d. Hold cover securely in place.
 - 2. Load application:
 - a. Do not apply uniform floor or roof loading for at least 12 hours after building masonry columns or walls.
 - b. Do not apply concentrated loads for at least 3 days after building masonry columns or walls.
- B. Staining:
 - 1. Prevent grout or mortar from staining the face of masonry to be left exposed or painted:
 - a. Remove immediately grout or mortar in contact with face of such masonry.
 - b. Protect all sills, ledges and projections from droppings of mortar, protect door jambs and corners from damage during construction.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specification for Cold Weather Masonry Construction.
- B. Hot Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

1.12 COORDINATION

- A. Coordinate work under provisions of Section 01 30 00.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Hollow Load Bearing Block Units (CMU): ASTM C90, Type I - Moisture Controlled; normal weight.
- B. Solid Load-Bearing Block Units (CMU): ASTM C90, Type I - Moisture Controlled; normal weight.

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- C. Hollow Non-Load Bearing Block Units (CMU): ASTM C129, Type I - Moisture Controlled; normal weight.
- D. Size and Shape: Nominal modular size of 8" x 16" x depth as indicated on the Drawings. Provide special units for 90 degree corners, bond beams, lintels and bullnosed corners.

2.2 REINFORCEMENT AND ANCHORAGE

- A. Multiwyhte and Singlewythe Joint Reinforcement: As specified in Section 04 05 20 - Joint Reinforcement and Bars
- B. Reinforcing steel: As specified in Section 04 05 20 - Joint Reinforcement and Bars
- C. Anchors and Ties: As specified in Section 04 05 19 - Masonry Anchors.

2.3 MORTAR AND GROUT

- A. Mortar: As specified in Section 04 05 13 - Masonry Mortaring.
- B. Grout: As specified in Section 04 05 16 - Masonry Grouting.

2.4 FLASHINGS

- A. Flashings: As specified in Section 07 65 00 - Flexible Flashings.

2.5 ACCESSORIES

- A. Preformed Control Joints: #D/A 2010 for horizontal joints below steel shelf angles and #D/A 2015 for vertical control joints; as manufactured by Dur-O-Wal, Inc., 3115 N. Wilke Road, Suite A, Arlington Heights, IL 60004 or equivalent products of the following manufacturers:
 - 1. AA Wire Products Company, 6100 New England Ave., Chicago, IL 60638.
 - 2. Heckmann Building Products Inc., 4015 W. Carroll Ave., Chicago, IL 60624.
 - 3. Hohmann & Barnard, Inc. 30 Rason Court, PO Box 5270, Hauppauge, NY 11788.
 - 4. Wire-Bond, PO Box 240988, 400 Roundtree Road, Charlotte, NC 28224.
- B. Cleaning Solution: As specified in Section 04 01 13 - Masonry Cleaning.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied to other Sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 CONSTRUCTION WORKMANSHIP

- A. All masonry units shall be stored on the jobsite so that they are protected from rain, stored off the ground and kept clean from contamination. Masonry work shall not start if the horizontal or vertical alignment of the foundation is more than one (1) inch in error.
- B. Masonry units shall be sound, dry, and clean from all foreign matter when placed in the wall.
- C. All masonry shall be laid true, level, plumb, and in accordance with the plans.
- D. Construction supports shall not be attached to the wall except where specifically permitted by the Architect.
- E. When placing masonry units that are to be left exposed, any noted variation of color and/or texture greater in range than normal shall be brought to the attention of the masonry contractor or masonry foreman. The placing of these units shall not continue until the units are approved for use by the manufacturer's representative.
- F. Extreme care shall be taken to prevent visible grout or mortar stains.
- G. Units shall be cut accurately to fit all plumbing ducts, openings, electrical work, etc., and all holes in cut units shall be neatly patched. All cuts shall be made with a masonry saw.

3.4 MIXING OF MORTAR

- A. Preblended Mortar shall be mixed in a mechanical batch mixer with the minimum amount of water to produce a workable consistency.
- B. Retempering mortar shall be required to maintain plasticity and workability. Retempering on mortar boards shall be done by adding water within a basin formed within the mortar. Rework the mortar into the water. No mortar shall be used beyond two and one half (2 1/2) hours from the time it was originally mixed.

3.5 MIXING OF GROUT

- A. Water content of the grout shall be adjusted to provide proper fluid consistency to enable placement under existing field conditions without segregation of the constituents. Mix thoroughly.

3.6 BONDING

- A. The top surface of the foundation shall be clean with laitance removed and roughened before the masonry work commences.
- B. Unless otherwise shown the masonry units shall be placed in a running bond or half bond pattern with straight uniform courses.
- C. Corners shall be solid grouted. Intersecting masonry walls and partitions shall be bonded at horizontal bond beams by the use of steel ties at 24 inches O.C. maximum.
- D. Structural members attached to the masonry shall be anchored to the walls with approved anchor bolts or their equivalent. Anchors shall be fully and solidly grouted in place.

3.7 JOINTS

- A. Mortar Joints:
 - 1. The starting joint on foundations shall be laid with full mortar coverage for the width of the face shells on the bed joint. All spaces to be filled with grout shall be kept free from mortar droppings so the grout will make full contact with the foundation.
 - 2. Vertical head joints shall be shoved tightly so that the mortar bonds well to both units. The width of the mortar joints shall be from the face of the block to at least the depth of the face shell. Horizontal bed joints shall be full.
 - 3. All mortar joints shall be clean, straight, and uniform in thickness.
 - 4. All mortar joints, unless otherwise specified, shall be concave and double struck to produce a dense, slightly concave surface well bonded to the surface of the masonry unit.

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- B. Control Joints:
 - 1. Control joints shall be placed according to the drawings. If the locations of the control joints are not shown on the drawings, the masonry contractor shall be responsible for obtaining the proper placement of the control joints from the architect or engineer.

3.8 LINTELS

- A. Openings Up To 42 inches Wide: Place two (2) No. 4 reinforcing bars one (1) inch from bottom web.
- B. Openings From 42 inches Up To 78 inches Wide: Place two (2) No. 5 reinforcing bars one (1) inch from bottom web.
- C. Openings Over 78 inches: Reinforce openings as detailed.
- D. Do not splice reinforcing bars.
- E. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- F. Place and consolidate grout fill without displacing reinforcing.
- G. Allow masonry lintels to attain specified strength before removing temporary supports.
- H. Maintain minimum 8 inch bearing on each side of opening.

3.9 BUILT-IN WORK

- A. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames, wood nailing strips, fireplace accessories, anchor bolts, plates, and other items to be built-in the work and furnished by other sections.
- B. Install built-in items plumb and level.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build in organic materials subject to deterioration.

3.10 REINFORCEMENT

- A. When a foundation dowel does not line up with the vertical cell of the masonry unit it may be bent into the proper location, the bending of the reinforcement shall not exceed more than one (1) inch horizontal to six (6) inches vertical.

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- B. All reinforcement shall be straight except for bends and/or hooks required for specific areas such as corners and intersecting walls as shown on the plans.
- C. Reinforcement bars shall be lapped forty (40) bar diameters minimum where spliced.
- D. Vertical bars shall be secured against displacement at intervals not to exceed two hundred (200) bar diameters.
- E. Horizontal reinforcement bars shall be continuous in bond beam courses, placed on the webs of the masonry units, and shall be solidly grouted in place.
- F. For coarse grout reinforcement steel shall have a minimum clearance of one-half (1/2) inch clearance from the inside face-shell of the masonry unit. For fine grout one-quarter (1/4) inch clearance may be used.
- G. Wire reinforcement shall be completely embedded in the mortar and/or grout. Mortar joints with wire reinforcement shall be at least twice the thickness of the wire diameter.
- H. Wire reinforcement shall be lapped at least six (6) inches at all splices and shall contain at least one cross wire of on each piece of reinforcement in the lapped distance.

3.11 GROUTING

- A. Reinforcement bars shall be in place and inspected prior to grouting.
- B. All cells and areas where grout is to be placed shall be free from mortar fins greater than one half (1/2) inch, droppings, and foreign materials that would prevent the wall from being properly grouted. Structural masonry walls shall be solid grouted unless otherwise specified. The placement of grout shall be stopped below the top of a mortar joint to form a grout key between pours.
- C. Segregation of grout materials and damage to the masonry shall be avoided during the grouting process.
- D. All grout shall be mechanically vibrated in place using a low velocity vibrator with a maximum head diameter of three-fourths (3/4) inch.
- E. When grout is placed in pours of twelve (12) inches maximum puddling may be specified. Vertical cells to be grouted shall be aligned to maintain a continuous unobstructed cell area.
- F. If partially grouted walls are specified, the cells containing reinforcement shall be solidly filled with grout and the placement of grout shall be

stopped below the top of a mortar joint to form a grout key between pours.

- G. Grouting of beams across openings shall be done in one continuous pour.
- H. All bolts, anchors, etc., inserted in the wall shall be solidly grouted in place.
- I. The spaces around all metal door frames and other built-in items shall be solidly grouted.
- J. Low Lift Grouting:
 - 1. In hollow unit masonry construction low lift grouting of the wall shall be done in pours not to exceed five (5) feet. Cleanouts are not required.

3.12 WALL CLEANING AND PROTECTION

- A. The masonry contractor shall take great care during construction to minimize any mortar or grout stains on the wall. Any stains that occur shall be removed immediately.
- B. After the wall is completed it shall not be saturated with water. During low humidity, the wall may be dampened with a fog spray during the curing period of the mortar.
- C. The tops of all unsheltered walls and partially completed walls shall be covered when work is not in progress.
- D. At the conclusion of the masonry work, the masonry contractor shall clean all masonry, remove all scaffolding and equipment used during construction, remove all debris, refuse, and surplus masonry material from the site.

3.13 TOLERANCES

- A. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- B. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- C. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- D. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

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END OF SECTION

**CONCRETE UNIT MASONRY
ISSUE FOR BID
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**SECTION 05 05 13
HOT DIP GALVANIZING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General contractor to provide galvanized coating applied to general steel articles, structural sections, fabricated steel assemblies and threaded fasteners where indicated.

1.2 REFERENCES

- A. American Galvanizers Association (AGA):
 - 1. Inspection of Product Hot Dip Galvanized After Fabrication
 - 2. The Design of Products to be Hot Dip Galvanized After Fabrication
 - 3. Recommended Details of Galvanized Structures.
- B. Research Council on Structural Connections of the Engineering Foundation: Specification for Structural Joints Using ASTM A325 or A490 bolts.
- C. Reference Standard:
 - 1. ASTM A 36 – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A 53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc Coated Welded and Seamless.
 - 3. ASTM A 120 – For Pipe, Steel, Black and hot-dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses.
 - 4. ASTM A 123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 5. ASTM A 143 – Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - 6. ASTM A 153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 7. ASTM A 242 – Standard Specification for High-Strength Low-Alloy Structural Steel.
 - 8. ASTM A 283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
 - 9. ASTM A 307 – Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength.
 - 10. ASTM A 325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 11. ASTM A 384 – Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
 - 12. ASTM A 385 – Providing Quality Zinc Coatings (Hot-Dip)\

13. ASTM A 394 – Standard Specification for Steel Transmission Tower Bolts, Zinc-Coated and Bare.
 14. ASTM A 441 – Specification for High-Strength Low-Alloy Structural Manganese Vanadium Steel.
 15. ASTM A 449 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 16. ASTM A 501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 17. ASTM A 529 – Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
 18. ASTM A 563 – Standard Specification for Carbon and Alloy Steel Nuts.
 19. ASTM A 780 – Repair of Damaged Hot-Dip Galvanized Coatings.
 20. B 6 Zinc (Slab Zinc)
- D. Certification: When requested by the purchaser/designer, a Certificate of Compliance shall be provided stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
- E. Inspection and Tests: Inspections, tests and samples shall conform to ASTM Specifications and Standards. Inspection shall be carried out at the galvanizers' plant by a designated party. Inspection rights and privileges, procedures, and acceptance or rejection of galvanized steel material shall conform to ASTM A 123 or A153 as applicable. Inspections and tests shall include the following:
1. Visual examination of samples or finished products, as appropriate.
 2. Tests to determine thickness or weight of zinc coating per square foot of metal surface.
 3. Adhesion.

1.3 SUBMITTALS

- A. Submit an original and two copies of the coating applicator's notarized Certificate of Compliance that the hot dip galvanized coating meets or exceeds the specified requirements of ASTM A123 / A123M (as applicable).
- B. Submit three 24"x 24" samples for each hot dip galvanized material for review by the Architect. The Architect's review shall be for color, texture, appearance, smoothness, etc. Approved samples shall become standards for the project and will be basis for acceptance or rejection of all hot dip galvanized work.
- C. Submit reports verifying chemical suitability of steel materials to be used in fabrications where hot dip galvanizing is the final finish.

1.4 HANDLING, TRANSPORT AND STORAGE

- A. Galvanized articles shall be loaded and stored as follows to prevent the formation of wet storage stain:
 - 1. The material shall be loaded in such a manner that continuous drainage could occur.
 - 2. In storage, the articles shall be raised from the ground and, if necessary, separated with strip spacers to provide free access of air to most parts of the surface. They shall also be inclined in a manner which will give continuous drainage. Under no circumstances shall galvanized steel be allowed to rest on cinders or clinkers; nor shall it be stored on wet soil or decaying vegetation.
- B. Load and store galvanized articles in accordance with accepted industry standards.

PART 2 PRODUCTS

2.1 ACCEPTABLE COATING APPLICATORS

- A. Members of the American Galvanizers Association or equal approved by the Architect.

2.2 STEEL MATERIALS

- A. Material for galvanizing to be geometrically suitable for galvanizing as described in ASTM A 384 and A 385. Steel material suitable for galvanizing includes structural shapes, pipe, sheet, fabrications and assemblies.
- B. Material to be chemically suitable for galvanizing. Steel used in highly visible fabrications where hot dip galvanizing is the final finish shall have low silicon content as well as levels of carbon, phosphorus and manganese content beneficial to the galvanizing process. Recommended steel materials for hot dip galvanizing include, but are not limited to:
 - 1. Structural shapes and plates: ASTM A 36, A242 type 2, A283, A441, A500, A501, A529, and A588.
 - 2. Steel for fasteners (ASTM):

| General Category | Bolt Material | Nut Material |
|---|-------------------|--------------|
| Carbon Steel | A 307 Gr. A or B | A 563 Gr. A |
| High Strength | A 325 Type 1 or 2 | A 563 Gr.DH |
| Tower Bolts | A 394 | A563 Gr A |
| Quenched & Tempered (Carbon Steel Bolts) | A 449 | A 563 Gr C |
| Quenched & Tempered | A 354 Gr BC | A 563 Gr DH |

3. Steel for sheet metal articles: ASTM A569 or A570.
4. Steel for pip or tubing: ASTM A53, A120 or A595 grade A or B.

2.3 ZINC FOR GALVANIZING

- A. Zinc for galvanizing shall confirm to ASTM B 6

2.4 FABRICATION REQUIREMENTS

- A. Fabricate structural steel in accordance with Class I, II, and III guidelines as described in AGA's *Recommended Details for Galvanized Structures*. Class I detailing to be utilized to the greatest extent possible at curtain wall components, structural fabrications and steel stairs where these fabrications are to be exposed to exterior environment. Class II may be utilized on fabrications where vent holes can be effectively plugged and are concealed from view. Class III detailing to be limited to internal or fully concealed components of exterior fabrications and to interior fabrications where intermittent welds are not visible from a normal point of view and have no adverse effect on the appearance or structural soundness of the fabrication.
- B. Fabrication practice for products to be galvanized shall be in accordance with the applicable clauses of ASTM A 143, A 384 and A 385. Care shall be taken to avoid fabrication techniques which could cause distortion or embrittlement of the steel during galvanizing. Before fabrication proceeds, the Architect/Engineer shall be notified of potential warpage problems which may require modification in design.
- C. The fabricator shall consult with the Architect and hot dip galvanizer regarding potential problems or potential handling problems during the galvanizing process, which may require modification of design before fabrication proceeds.
- D. Remove all welding slag, splatter, anti-splatter compounds, and burrs prior to delivery to the galvanizer.
- E. Provide holes and/or lifting lugs to facilitate handling during the galvanizing.
- F. Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil paint and other deleterious material prior to fabrication.
- G. Remove by blast cleaning or other methods, surface contaminants and coatings that would not be removable by the normal chemical cleaning process in the galvanizing operation.

- H. Whenever possible, slip joints should be used to minimize field welding of material.

2.5 REPAIR COMPOUND

- A. Repair Compound: ZRC Galvilite Galvanizing Repair Compound as manufactured by ZRC Worldwide, 145 Enterprise Drive, Marshfield, MN 02050, 781-319-0400

PART 3 EXECUTION

3.1 SURFACE PREPARATION

- A. Steelwork shall be prepared utilizing a caustic bath, acid pickle and flux. Where appropriate, the steel can be blast cleaned and fluxed.

3.2 APPLICATION OF COATING

- A. Galvanize steel members, fabrications, and assemblies after fabrication by the hot dip process in accordance with ASTM A123/A123M.
- B. Galvanize bolts, nuts and washers and iron and steel hardware components in accordance with ASTM A153/A153M.
- C. Safeguard products against steel embitterment in conformance with ASTM A143/A143M.
- D. Galvanize reinforcing steel in accordance with ASTM A767.
- E. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

3.3 COATING REQUIREMENTS

- A. Coating Weight: Provide coating weights per Table 1, ASTM A 126 with a minimum coating thickness on any galvanized item of 460g/sq. m. (Grade 65) Conform with paragraph 5.1 of ASTM A123/A123M, Table 1 of A767, or Table 1 of ASTM A153/A153M as appropriate. Special thickness requirements should refer to ASTM A123/A123M, 3.1.7 and be specified to the minimum average mils of thickness.
- B. Surface Finish: Continuous, adherent, as smooth, and evenly distributed as possible and free from defect detrimental to the stated end use of coated article.
- C. The integrity of the coating shall be determined by visual inspection, coating thickness measurements, and adhesion testing.

- D. Where slip factors are required to enable friction grip bolting, these shall be obtained after galvanizing by suitable treatment of the faying surfaces in accordance with the latest edition of the Specification for Structural Joints Using ASTM A 355 or A 490 Bolts as approved by the Research Council on Structural Connections of the Engineering Foundation.
- E. Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

3.4 SURFACE GLARE REQUIREMENTS

- A. Deglaring: Deglaring of coated articles intended for interior applications is to be provided by allowing coated articles to attain a minimum of Stage 2, Zinc Hydroxide oxidation by exterior exposure to weather.
- B. Handling: Handle coated articles having attained Stage 2 oxidation with care to prevent damage to the oxidized finish.

3.5 GALVANIZING

- A. Steel members, fabrications, and assemblies shall be galvanized after fabrication by the hot dip process in accordance with ASTM A 123.
- B. Bolts, nuts and washers and iron and steel hardware components shall be galvanized in accordance with ASTM A 153. Nuts and bolts shall be supplied in accordance with ASTM A 194, A 307, A 325, A 394 or A 563, as applicable.
- C. Products shall be safeguarded against steel embrittlement in conformance with ASTM A 143.
- D. All articles to be galvanized shall be handled in such a manner as to avoid any mechanical damage and to minimize distortion.
- E. When the galvanizer detects design features which may lead to difficulties during galvanizing, he shall point them out to the fabricator and arrange for modifications to be made prior to dipping.
- F. The composition of metal in the galvanizing bath shall not be less than 98% zinc.

3.6 WELDING

- A. Where galvanized steel is to be welded, adequate ventilation shall be provided. If adequate ventilation is not available, supplementary air circulation shall be provided. In confined spaces a respirator shall be used.
- B. Welding shall be performed in accordance with the American Welding Society publication D19.0-72, Welding Zinc Coated Steel.

- C. All uncoated weld areas shall be touched up.

3.7 TESTS

- A. Inspection and testing of hot dip galvanized coatings shall be done under the guidelines provided in the AGA publication Inspection of Products Hot Dip Galvanized After Fabrication.
- B. Include visual examination and tests in accordance with ASTM A123/A123M or A153/A153M as applicable to determine the thickness of the zinc coating on the metal surface.
- C. Furnish Notarized Certificate of Compliance with ASTM Standards and Specifications herein listed. The Certificate must be signed by the galvanizer and contain a detailed description of the material processed. The Certificate shall include information as to the ASTM standard used for the coating.

3.8 FINAL FINISHING

- A. Hot dip galvanized surfaces shall be smooth and free of burrs, projections or fins.

3.9 TOUCH UP AND REPAIR

- A. Mechanical Damage:
 - 1. Areas damaged by welding, flame cutting, or during handling, transport or erection shall be repaired by one of the following methods whenever the damage exceeds 3/16" in width on flat surfaces of 1/10 inch on cut ends:
 - a. Cold Galvanizing Compound
 - 1) Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease and corrosion products.
 - 2) Areas to be repaired shall be power disc sanded to bright metal. To ensure that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
 - 3) Touch-up paint shall be an organic cold galvanizing compound having a minimum of 65% zinc dust in the dry film.
 - 4) The paint shall be spray or brush applied in multiple coats until a dry film thickness of 4 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
 - 5) Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

- b. Zinc Based Solder
 - 1) Surfaces to be reconditioned with zinc based solder shall be clean, dry, and free of oil, grease and corrosion products.
 - 2) Areas to be repaired shall be wire brushed and given a thin layer of acidic paste flux.
 - 3) Heat shall be applied slowly and broadly close to, but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc based solder shall be applied to a minimum thickness equivalent to that of the undamaged coating.
 - 4) Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
 - c. Metallizing
 - 1) Surfaces to be reconditioned with zinc metal spray shall be clean, dry, and free of oil, grease and corrosion products.
 - 2) The area to be repaired shall be grit blasted to white metal followed by zinc metal spraying to a coating thickness equivalent to that of the undamaged coating, and seal coated using an aluminum-vinyl paint.
- B. Wet Storage Stain
- 1. Any wet storage stain shall be removed by the galvanizer if formed and discovered prior to leaving the galvanizer's plant, unless late pick up or acceptance of delivery has necessitated the material being stored in unfavorable conditions. In any event, wet storage stain shall be removed before installation to prevent premature failure of the coating. Wet storage stain shall be removed as follows.
 - a. The objects shall be arranged so that their surfaces dry rapidly.
 - b. Remove light deposits with a stiff bristle (not wire) brush. Heavier deposits are to be removed by brushing with an acidic based metal cleaner. The surfaces cleaned shall be thoroughly rinsed with water.
 - c. A coating thickness check must be made in the affected areas to ensure that the zinc coating remaining after the removal of wet storage stain is sufficient to meet or exceed the requirements of the specification.

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3.10 REPAIR OF DAMAGED COATING

- A. Repair areas damaged by welding, flame cutting or during handling, transport or erection, by one of the approved methods in accordance with ASTM A 780 whenever damage exceeds 3/16 inch in width. Minimum thickness requirements for the repair are those described in ASTM A 123 Section 4.6 current edition

END OF SECTION

**SECTION 05 12 00
STRUCTURAL STEEL**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel framing members and all related accessories such as structural embeds, connections, bolts, welds, fasteners, threaded rods, headed studs, including fabrication, erection and all related work and accessories.
 - 2. Framing around openings larger than 6" in roof and floor deck systems.
 - 3. Connections and other performance specified items, including related design by contractor's specialty structural engineer.
 - 4. Temporary bracing and shoring, including related design by contractor's specialty structural engineer.
 - 5. Shop applied finishes and coatings, including preparation, primers, special paint systems or galvanizing on steel exposed to exterior or aggressive environments, and bitumastic coating on steel below grade in soil.
 - 6. Grouting for base plates, seats and bearing areas.
- B. Related Sections include the following:
 - 1. Division 01 Section "Structural Tests and Special Inspections" for independent testing agency procedures and administrative requirements.
 - 2. Division 03 Section "Concrete" for items attached to formwork, anchors and embeds to be cast in concrete.
 - 3. Division 04 Section "Unit Masonry" for items attached to masonry, anchors and embeds to be set in masonry.
 - 4. Division 05 Section "Steel Floor Deck" for field installation of shear connectors.
 - 5. Division 05 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other metal items not defined as structural steel.
 - 6. Division 09 Section "Painting" for surface preparation and priming requirements.

1.3 REFERENCES

- A. American Institute of Steel Construction (AISC):
 - 1. Code of Standard Practice for Buildings and Bridges.
 - 2. Manual of Steel Construction.
- B. American Society for Testing and Materials (ASTM).
- C. American Welding Society (AWS):
 - 1. AWS D1.1 - Structural Welding Code - Steel.
 - 2. AWS D1.3 - Structural Welding Code – Sheet Metal.
- D. International Building Code (IBC).

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- E. Minnesota State Building Code (MSBC).
- F. Research Council on Structural Connections (RCSC): Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.
- G. The Society for Protective Coatings (SSPC):
 - 1. Standard Procedure for Evaluating Qualifications of Shop Painting Applicators.

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear and moment connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD (service) or LRFD loads as indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC's "Manual of Steel Construction", as indicated in the contract documents.
 - 2. Engineering Responsibility: Fabricator's responsibilities include engaging a specialty structural engineer to prepare structural analysis data and submit calculations for structural-steel connections.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings and related submittals: Show complete information for fabrication and erection of structural-steel components.
 - 1. Submit shop drawings under provisions of Division 1 Section "Submittal Procedures". Phase submittals to match sequence of actual construction to avoid delay of work. Field verify all existing conditions impacting this work and add relevant field information to shop drawings, prior to submittal of shop drawings.
 - 2. Indicate profiles, sizes, spacing, and locations of structural members, connections, attachments, fasteners, cambers, loads, welds, and headed studs. Cut erection details where details are cut on structural plans and add erection details as needed. Provide erection plans, erection details and member detail sheets. If partial area submittals are made, submit all related sheets and cloud related plan areas. Reference specific structural plans and details from which information is drawn or submittals will be rejected.
 - 3. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths and weld capacities. Indicate shop and field welds and sequence of erection.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. Provide setting drawings, templates and directions for the installation of the anchor rods and other anchoring devices, including embedments.
 - 6. Welders Certificates: Submit under provisions of Division 1 Section "Submittal Procedures". Welder's Certificates, certifying welders employed on the Work obtained appropriate AWS qualification within the previous 12 months.
 - 7. Calculations: Contractor shall engage a specialty structural engineer to perform final design calculations and submit same, for all connections not fully designed and detailed on the drawings by the Structural Engineer of Record (SER). Design for the criteria indicated here-in and as shown on the drawings. Submit signed calculations same day as steel framing shop drawings to which they relate, to ensure compatibility between specialty engineers calculations and shop drawings.
- C. Qualification Data: For erector and fabricator.

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- D. Mill Test Reports: Submit under provisions of Division 1 Section "Submittal Procedures". Signed by manufacturers certifying that the following products comply with requirements:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Direct-tension indicators.
 - 4. Tension-control, high-strength bolt-nut-washer assemblies.
 - 5. Shear stud connectors.
 - 6. Shop primers.
 - 7. Non-shrink grout.
 - 8. Other structural elements as indicated on the documents.
- E. Source quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Installer (Erector) Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.
- B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant. Fabricator shall be experienced in preparation of shop drawings using integrated three-dimensional modeling software parametrically linking all major structural piece marks and overall building framing model.
- C. Specialty Structural Engineer Qualifications: Employ professional Engineer, registered in Minnesota, to perform design of connections to meet structural performance requirements. Sign and seal design Shop Drawings submitted to Owner for review.
- D. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- E. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- F. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. AISC's "Specification for Structural Steel Buildings."
 - 3. AISC's "Specification for the Design of Steel Hollow Structural Sections."
 - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 5. Coordinate finish painting requirements with Division 09 Sections "Painting" or "High-Performance Coatings".
- G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- H. Contractor shall assign a qualified staff member to perform quality control on their own work in the field on a daily basis, for each day work is performed. The Contractor's quality control staff shall review their own work for compliance with contract documents before the Contractor notifies the design team or others, of readiness for required inspections, tests and observations to be provided by the Owner's Representatives.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 FIELD MEASUREMENTS

- A. Verify actual locations of existing structure, new work previously placed and other construction to which the new work must fit by accurate field measurements before submittal of related shop drawings or fabrication. Show recorded measurements on shop drawings submitted for review. Coordinate fabrication schedule with construction progress to avoid delay of Work. Where work will be connected to existing masonry or concrete, contractor shall engage a testing agency to pre-locate hidden embeds and reinforcing steel prior to submittal of shop drawings. Provide templates and dimensions to fabricator for accurate alignment with existing conditions. Show field conditions impacting the work on the shop drawings, prior to submittal.

1.9 COORDINATION

- A. Deliver anchor rods and other anchorage devices to be embedded in concrete or masonry construction to site in time for installation without impact on schedule. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992, Grade 50.
- B. Channels, Angles, Plate and Bar: ASTM A 36.
- C. Corrosion-Resisting Structural Steel: ASTM A 588, Grade 50.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847, structural tubing.
- F. Steel Pipe: ASTM A 53, Type E or S, Grade B, Finish.
 - 1. Weight Class: As indicated on the documents.
 - 2. Finish: Black, except where indicated to be galvanized.
- G. Welding Electrodes: E70XX, comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 or ASTM A 490, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

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1. Finish: Plain.
2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type.
 - a. Finish: Plain.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 1. Finish: Plain.
- C. Shear Connectors or Headed Concrete Anchors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B. The ferules shall be specifically designed for the weld-through technique.
- D. Unheaded Anchor Rods: ASTM F 1554, Grade 36 or as indicated on Drawings.
 1. Configuration: Straight with nut and washer, unless specifically indicated to be hooked on the drawings.
 2. Nuts: ASTM A 563 heavy hex carbon steel.
 3. Plate Washers: ASTM A 36 carbon steel.
 4. Washers: ASTM F 436 hardened carbon steel.
 5. Finish: Plain
- E. Headed Anchor Rods: ASTM F 1554, Grade 36 unless otherwise indicated.
 1. Nuts: ASTM A 563 heavy hex carbon steel.
 2. Plate Washers: ASTM A 36 carbon steel.
 3. Washers: ASTM F 436 hardened carbon steel.
 4. Finish: Plain.
- F. Expansion Bolts:
 1. Manufactures:
 - a. Liebig International, Ultraplus
 - b. Hilti, Kwik-Bolts II
 - c. ITW Ramset/Redhead, Trubolt
 - d. Wej-it Expansion Products, Inc. Wej-it Bolts
 2. If embedment length is not indicated on the drawings, provide embedment length recommended by the manufacturer to develop full strength of bolt.
- G. Adhesive Anchors into Solid Masonry or Concrete:
 1. Manufacturers:
 - a. Hilti, HIT RE 500
 2. Rods:
 - a. Standard rods per ASTM A36.
 - b. Super rods per ASTM A193 Grade B7.
 - c. Stainless steel rods per ASTM F593 Condition CW.
 - d. Reinforcement bar per Section 03200.
 3. If embedment length is not indicated on the Drawings, provide embedment length recommended by manufacturer to develop full strength of bolt.
 4. Provide rods threaded full length with 45 degree bevel cut at base.
- H. Self-lubricating Bearing Elements:
 1. Manufacturers:
 - a. Seismic Energy Products, SEP Bearings.
 2. Composition of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates prebonded to appropriate steel backing materials, of size and thickness indicated on drawings.

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- I. Clevises and Turnbuckles: ASTM A 108, Grade 1035, cold-finished carbon steel.

2.3 PRIMER

- A. Primer:
 - 1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
 - 2. Color: Fabricator's standard.
- B. Galvanizing Repair Paint: ASTM A 780.
- C. Bituminous Protection Coating: Carboline, Bitumastic 50

2.4 GROUT

- A. Nonmetallic, High Strength, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time. F'c=4000 psi minimum at 24 hours.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings" as indicated on the documents.
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A6 and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Fabricate heavy shapes and connections (ASTM A6-Group 4 and 5 Rolled shapes) in accordance with AISC Manual of Steel Construction, Part 5, Paragraph A.3.C and related requirements for finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- D. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning or SSPC-SP 2, "Hand Tool Cleaning."
- E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- F. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened or as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 - 3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials.
 - 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Painting: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 2 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
 - 1. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.
 - 2. Fill vent holes and grind smooth after galvanizing.

2.9 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports in accordance with the quality control program indicated for Field Quality Control, unless the fabricator maintains AISC Certification.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of new and existing support surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements. Verify dimensions that affect the new work including gridlines, column and beam centerlines, face of wall, etc.
- B. Remove and replace existing finishes, utilities and other obstructions that may impede proper access for verification of conditions and installation of new work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings", as indicated on the drawings.
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Snug-tighten or Pretension anchor rods, as indicated on the drawings, after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base and bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection unless approved by structural engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions. The top flanges of the beams receiving stud shear connectors shall be free of any substances that might interfere with the welding operations. During welding the steel decking panels shall be free of detrimental substances and rest tightly upon the top flange of the beam.
- J. No trades may field cut or alter structural members without specific approval of the Structural Engineer. Submit dimensioned plan and detail sketch of proposed modification under cover of an RFI or cloud proposed changes on shop drawings.

- K. Provide deck support framing typically around openings in roof and floor deck cutting more than one deck rib. Also provide support thus where openings cutting only 1 rib occur within 24" of each other in the same deck span. Typical support detail is shown on the drawings. Not all openings are shown on the structural drawings. Fabricator shall coordinate with Mechanical, Electrical, Roofing contractors and other associated trades to include all such work in base bid and determine final locations as required.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened or as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds. Contractor shall remove all weld slag using pick and brush to expose bright steel for self-verification of workmanship by the contractor and for Quality Assurance access by testing agency. This shall be done on a daily basis as welding proceeds.
 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
- C. Tension Control Devices:
1. Install using electric power wrench as recommended by bolt manufacturer.
 2. Tighten until splined end of bolt is sheared off.
- D. Expansion Bolts or Adhesive Anchors: Install according to manufactures published instructions.
- E. Shear Connectors:
1. Do not weld when the temperature is below 0 degrees F.
 2. Remove standing water in deck ribs so that water is not trapped between beams and deck during welding.
 3. Ensure that surfaces of steel beams to which studs are to be welded are dry and free of paint, dirt and debris and that deck bottom is in firm contact with beam.
 4. Install studs after steel framing and metal decking are in place.
 5. Use automatic welding equipment powered to weld studs satisfactorily under site conditions.
 6. Prior to starting each day's operations, weld at least two shear studs to determine proper generator control unit and stud welder settings.
 7. Test that studs are capable of being bent 45 degrees from vertical without weld failure.
 8. Weld additional trial shear studs at request of ITL.
 9. Minimum projection of stud above top of deck: 1-1/2 inches.

3.5 FIELD QUALITY CONTROL

- A. The Owner will engage a qualified testing and inspection agency to provide special inspection and testing services and prepare reports in accordance with Division 1, Section “Structural Tests and Special Inspections”, and with IBC 2006 Chapter 17 as adopted by the 2007 MSBC, and the CASE/Mn Guideline for Special Structural Inspection and Testing, and other items which in the professional judgement of the Structural Engineer of Record, are critical to the integrity of the building structure.
- B. Special Inspection and Testing Criteria
 - 1. General
 - a. If special inspection of fabricators work is required in the shop, testing agent may test and inspect structural steel at plant before shipment. Owner and SER reserve right to reject material not complying with Contract Documents at any time before final acceptance.
 - 2. Definitions
 - a. Refer to Division 1, Section “Structural Tests and Special Inspections” for standard requirements.
 - b. A.S.N.T.: The American Society for Non-destructive Testing
 - c. N.D.E.: Non-destructive Evaluation
 - d. A.W.S./C.A.W.I.: American Welding Society / Certified Associate Weld Inspector
 - e. A.W.S./C.W.I.: American Welding Society / Certified Weld Inspector
 - f. Special Inspector – Technical: Shall be employed by a testing agency and shall be supervised by an A.W.S./C.W.I. with a minimum of 10 years experience, or an A.S.N.T. Level III with a minimum of 10 years experience. These individuals shall satisfy the following requirements:
 - 1) Technical I: Non-destructive Testing Technician A.S.N.T.-TC-1A Level I, and/or A.W.S. Certified Associate Weld Inspector (C.A.W.I.)
 - 2) Technical II: Nondestructive Testing Technician A.S.N.T.-TC-1A Level II (NDE Technician II), A.W.S./C.A.W.I. with minimum 3 years experience, or an A.W.S./C.W.I
 - 3) Technical III: A.S.N.T. Level III with a minimum of 10 years experience or an A.W.S./C.W.I with a minimum of 10 years experience.
 - g. Special Inspector – Structural
 - 1) Structural I: Graduate civil/structural engineer, or other personnel acceptable to the SER, with experience in the design of structural systems of this type. Inspections shall be performed under the direct supervision of a licensed civil/structural engineer.
 - 2) Structural II: Civil/structural engineer regularly engaged in the design of structural systems of this type, licensed in the state in which the project is located. The licensed engineer shall review and approve all inspection reports.
 - 3) Special Inspector – Structural may be an employee of the SER.
 - 3. Special Testing and Inspection Requirements
 - a. High Strength Bolting (Field Installed).
 - 1) General (Technical II)
 - a) Visually inspect mating surfaces and bolt type for all slip-critical bolted connections for general conformance with the contract documents prior to bolting.
 - b) Determine the requirements for bolts, nuts, washers, paint and installation/tightening standards are met.
 - c) Observe calibration procedures when such procedures are required in the contract documents and verify that selected procedure is used to tighten bolts.
 - 2) Slip Critical Bolts and Tension Bolts (Technical II)

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- a) Test bolt tightening in 10% of all bolts. Test a minimum of two bolts in each connection. Verify that all plies of connected elements have been brought into contact, at 100% of connection. Verify all tips are removed from “twist-off” bolts.
- 3) Bearing Bolts (Technical II)
 - a) Visually inspect to conform all plies of connected elements have been brought into contact, at 100% of connections. (Applies only to bolts designed for values not requiring exclusion of threads from failure plane, all other bolts require testing as for tension bolts.)
- 4) Standard
 - a) Test High Strength bolted connections per R.C.S.C. Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
- b. High Strength Bolting (Shop Installed) (Technical II)
 - 1) For shop fabricated work, perform tests required for field installation, except that bolt testing may be reduced or deleted, if fabrication shop satisfies AISC Quality Certification Program – Category I, or more stringent criteria, or is approved by SER.
- c. Welding (General): The Special Inspector shall perform the following (Technical II):
 - 1) Prior to start of fabrication, determine if fabrication shop meets the criteria for exempting shop welds from inspection and confirm in writing to SER.
 - 2) Verify qualifications of all welders as AWS certified.
 - 3) Verify proposed welding procedures and materials.
 - 4) Verify adequate preparation of faying surfaces.
 - 5) Verify preheat and interpass temperature of steel, proper technique and sequence of welding, and cleaning and number of passes are provided as required.
- d. Welding (Field)
 - 1) Fillet Welds (Technical II)
 - a) Visually inspect 100% of all fillet welds for size, length and quality per AWS D1.1.
 - 2) Partial Penetration Welds (Technical II)
 - a) Test 100% of all partial penetration welds exceeding 5/16 inch, using Ultrasonic Tester per AWS D1.1. Test 25% of all partial penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E109, performed on root pass on finished weld.
 - 3) Full Penetration Welds (Technical II)
 - a) Test 100% of all full penetration welds exceeding 5/16 inch, using Ultrasonic Tester per AWS D1.1. Test 25% of all full penetration welds less than 5/16 inch, using Magnetic Particle Testing per ASTM E109, performed on root pass on finished weld.
 - 4) Stud Shear Connector Welds (Technical I)
 - a) Visually inspect 100% of installed studs for full 360 degree flash. Test all questionable studs, not showing full 360 degree flash by bending studs 15 degrees from vertical, away from weld discontinuity, per AWS D1.1. All ceramic welding ferrules shall be removed by contractor. Randomly test all other studs by bending to 15 degrees from vertical as noted:
 - Studs welded through deck: 15%
 - Studs welded to bare steel: 5%Alternatively, sound 100% of installed studs, for full penetration weld, using an 8 lb. Maul. Test questionable studs as noted above. Welding ferrules need not be removed.
 - 5) Deck Welds and Fasteners (Technical I)

- a) Visually inspect size, location, length and burn through for 100% of puddle welds on metal deck designed as a structural element, per AWS D1.3.
- b) Visually inspect sidelap fasteners to meet spacing and size specified.
- 6) Welding of Reinforcing Bars (Technical II)
 - a) Be continuously present during welding and visually inspect 100% of all reinforcing bar welds as the welding is performed, per AWS D1.4. Verify proper joint preparation is provided and proper electrodes are used and properly store and dried.
- e. Welding (Shop)
 - 1) Perform inspections as for field welding except weld testing may be reduced or deleted, if fabrication shop satisfies AISC Quality Certification Program – Category I, or more stringent criteria, or is approved by SER.
- f. Mechanical Fasteners (Misc.)
 - 1) Fasteners (Technical I)
 - a) Visually inspect specified size, spacing, embedment, and location of expansion bolts and adhesive bonded bolts in connections shown on the structural drawings.
- g. Structural Configuration
 - 1) Submittals (Structural I)
 - a) Verify mill test reports and other submitted documentation for compliance with contract documents.
 - 2) Materials (Technical I)
 - a) Verify materials delivered to site comply with contract documents and approved shop drawings. Materials include bolts, electrodes, mechanical fasteners and deck gauge.
 - 3) Detail Compatibility (Structural I) On a periodic basis:
 - a) Review project documents affecting integrity of the structure, including contract documents and pertinent submittals (approved shop drawings)
 - b) Visit site, at intervals appropriate to the stage of construction, to perform review of the structure and visually confirm general compliance with the project documents.
 - c) Inspect the following to verify member orientation, configuration, type and size comply with details indicated on the contract documents and approved shop drawings:
 - Bracing and stiffening members.
 - Proper applications of joint details at connections for structural members.
 - Other work critical to the integrity of the building structure.
- 4. Conventional Testing and Inspection Requirements
 - a. High Strength Bolting
 - 1) Bolt Material Test (Technical II)
 - a) Test a minimum of two bolts of each ASTM class specified, for bolt hardness and tensile properties.
 - 2) Fabrication and Erection Tolerances (Owner's Construction Manager)
 - a) Verify in-place structure satisfies specified tolerances

3.6 REPAIRS AND PROTECTION

- A. If tests or inspections indicate Work does not meet specified requirements, remove work, replace and retest at no cost to Owner.
- B. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

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- C. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 051200

**SECTION 05 31 13
STEEL FLOOR DECK**

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. Composite steel deck.
 - 2. Non-composite steel form deck.
 - 3. Related accessories.
- B. Related Requirements:
 - 1. Division 01 Section "Structural Testing and Special Inspections".
 - 2. Division 03 Section "Cast-In-Place Concrete".
 - 3. Division 05 Section "Structural Steel".
 - 4. Division 07 Sections for thermal and moisture protection, and applied fireproofing.
 - 5. Division 09 Sections for painting and coating of exposed deck.

1.3 REFERENCES

- A. American Iron and Steel Institute (AISI):
 - 1. North American Specification for the Design of Cold-Formed Steel Structural Members.
 - 2. Cold-Formed Steel Framing Standards.
- B. American Society for Testing and Materials (ASTM).
- C. American Welding Society (AWS):
 - 1. AWS D1.1 - Structural Welding Code - Steel.
 - 2. AWS D1.3 - Structural Welding Code – Sheet Metal.
- D. Steel Deck Institute (SDI): Steel Deck Institute Design Manual for Composite Decks, Form Decks, and Roof Decks - Publication No. 31.
- E. The Society for Protective Coatings (SSPC): SSPC Paint 20 - Zinc-Rich Coating.
- F. Underwriters Laboratories, Inc. (UL).
 - 1. UL 209 - Cellular Metal Floor Raceways and Fittings.
 - 2. Electrical Construction Equipment Directory.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
 - 1. Include name of deck manufacturer as well as type, depth, gauge and finish of deck.
- B. Shop Drawings:

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1. Show layout and types of deck panels, anchorage details, attachment patterns, field welding requirements, side lap fastenings, pans, cut deck openings, special jointing, closure plates, tabs or holes for ceiling hangers, trench headers, preset service fittings, prepunched holes for fittings, accessories, and attachments to other construction required for complete installation of decking.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 1. Powder-actuated mechanical fasteners.
 - a. Substitute for deck welds at contractor's option. Product data and test reports shall demonstrate fasteners have equal or greater capacity than welds indicated and are suitable for attachment to base material.

1.5 INFORMATIONAL SUBMITTALS

- A. Submittal Schedule for all action submittal items.
- B. Product Certificates: For each type of steel deck, signed by product manufacturer certifying that products furnished comply with the requirements.
- C. Welding certificates.
- D. Research/Evaluation Reports: For steel deck.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Fabricate panels to comply with dimensional parameters as defined in "Design Manual for Composite Decks, Form Decks, and Roof Decks" in SDI Publication No. 31. Section properties shall be based in accordance with the AISI Specification for the Design of Cold-Formed Steel Structural Members.
- B. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1 and D1.3 Structural Welding Codes.
- D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
- C. Keep construction loads and stored materials, including other decking, off steel deck until it is permanently fastened and inspected.

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- D. Do not overload deck beyond 75 percent of rated normal capacity with stored materials or equipment.

1.8 COORDINATION

- A. Provide decking to receive spray-applied fire-resistive materials (SFRM) free of amounts of lubricant or other contaminants which would significantly impair adhesion of sprayed materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 COMPOSITE STEEL DECK

- A. Available Products:
 - 1. Nucor Corp.; Vulcraft Division: Type VLI.
 - 2. Wheeling Corrugating Company: Super-Bond.
- B. Fabricate panels, with integrally embossed or raised pattern ribs, and interlocking side laps to comply with dimensional parameters as defined in "Design Manual for Composite Decks, Form Decks, and Roof Decks" in SDI Publication No. 31. Section properties shall be based in accordance with the AISI Specification for the Design of Cold-Formed Steel Structural Members.
- C. Galvanized Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 50, zinc coating.
- D. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 50,] zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard baked-on, rust-inhibitive primer.
- E. Section Properties: Deck profile, depth, design uncoated steel thickness, and finish shall be as indicated on Drawings.
- F. Span Condition: As indicated on drawings.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

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- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- G. Galvanizing Repair Paint: Manufacturer's Standard.
- H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: As indicated on Drawings.
 - 2. Weld Spacing: Space and locate welds as indicated on Drawings.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, as indicated on Drawings.
 - 1. Button punching is NOT allowed.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.4 PROTECTION AND REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on bottom surface of prime-painted deck exposed to view immediately after installation, and apply repair paint of same color as adjacent shop-primed deck.
 - 1. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 09.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.
- D. No hangers, fasteners or loads shall be hung from the underside of the deck unless specifically indicated thus on the structural drawings. Such items as mechanical/electrical equipment, utility lines, architectural bulkheads, ceilings, signage, etc, shall have their own sub-framing designed, supplied and installed by their related trade, as required span to adjacent beams, joists or walls for any support needed.

3.5 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified special inspector and independent testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with Division 01 Section "Structural Testing and Special Inspections".
- B. Inspections:
 - 1. Visually inspect size, location, length and burn-through for 100% of puddle welds on metal deck, per AWS D1.3, Section 6. (Technical I).

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2. Visually inspect size, location, and seating for 100% of powder-actuated or pneumatically driven fasteners on metal deck, per AWS D1.3, Section 6. (Technical I).
 3. Report inspection results promptly and in writing to Contractor and Architect.
- C. Deck panels shall be clean, dry, and in firm contact with substrate prior to welding.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

END OF SECTION 05 31 13

**SECTION 05 31 23
STEEL ROOF DECK**

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. Roof deck.
- B. Related Requirements:
 - 1. Division 01 Section "Structural Testing and Special Inspections".
 - 2. Division 05 Section "Structural Steel".
 - 3. Division 07 Sections for thermal and moisture protection, and applied fireproofing.
 - 4. Division 09 Sections for painting and coating of exposed deck.

1.3 REFERENCES

- A. American Iron and Steel Institute (AISI):
 - 1. North American Specification for the Design of Cold-Formed Steel Structural Members.
 - 2. Cold-Formed Steel Framing Standards.
- B. American Society for Testing and Materials (ASTM).
- C. American Welding Society (AWS):
 - 1. AWS D1.1 - Structural Welding Code - Steel.
 - 2. AWS D1.3 - Structural Welding Code – Sheet Metal.
- D. International Code Council - Evaluation Service (ICC-ES): Evaluation Reports.
- E. Steel Deck Institute (SDI): Steel Deck Institute Design Manual for Composite Decks, Form Decks, and Roof Decks - Publication No. 31.
- F. The Society for Protective Coatings (SSPC): SSPC Paint 20 - Zinc-Rich Coating.

1.4 SUBMITTALS FOR REVIEW

- A. Product Data: For each type of deck, accessory, and product indicated.
 - 1. Include name of deck manufacturer as well as type, depth, gauge and finish of deck.
- B. Shop Drawings:
 - 1. Show layout and types of deck panels, anchorage details, attachment patterns, field welding requirements, side lap fastenings, pans, cut deck openings, special jointing, accessories, and attachments to other construction required for complete installation of decking.
 - 2. Describe types and locations of acoustical materials and closures.
 - 3. Include deck manufacturer's ICC-ES Evaluation Report Number.

- C. Certificates:
 - 1. Product Certificates: For each type of steel deck, signed by product manufacturer.
 - 2. Welding certificates signed by contractor certifying that welders comply with requirements of Article 1.4 – “Quality Assurance.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Powder-actuated mechanical fasteners.
 - a. Substitute for deck welds at contractor’s option. Product data and test reports shall demonstrate fasteners have equal or greater capacity than welds indicated and are suitable for attachment to base material.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Fabricate panels to comply with dimensional parameters as defined in “Design Manual for Composite Decks, Form Decks, and Roof Decks” in SDI Publication No. 31. Section properties shall be based in accordance with the AISI Specification for the Design of Cold-Formed Steel Structural Members.
- B. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1 and D1.3 Structural Welding Codes.
- D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.
- C. Keep construction loads and stored materials, including other decking, off steel deck until it is permanently fastened and inspected.
- D. Do not overload deck beyond 75% rated capacity with stored materials or equipment.

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:
 - 1. Canam Steel Corp.
 - 2. Epic Metals Corporation.

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3. Nucor Corp.; Vulcraft Division.
4. United Steel Deck, Inc.
5. Verco Manufacturing Co.
6. Wheeling Corrugating Company.

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 1. Prime-Painted Steel Sheet: ASTM A 1008, Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 2. Galvanized Steel Sheet: ASTM A 653, Grade 33 zinc coating.
 3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Grade 33, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 4. Deck Profile: As indicated on Drawings
 5. Profile Depth: As indicated on Drawings
 6. Design Uncoated-Steel Thickness: As indicated on Drawings
 7. Span Condition: As indicated on Drawings
 8. Side Laps: As indicated on Drawings.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, powder-actuated or pneumatically driven carbon-steel fasteners with knurled shank.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, of same thickness, material and finish as deck; of profile indicated or required for application.
- F. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch thick (14-ga), of same material and finish as deck. For drains, cut holes in the field.
- G. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.
- H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck at contractor's option. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members as indicated on drawings.
 - 1. Cover weld burn holes with metallic tape.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated on Drawings (minimum 2 per span) and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - 2. Button punching is NOT allowed.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.

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- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 8 inches apart with at least one weld at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and weld.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 PROTECTION AND REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.
- D. No hangers, fasteners or loads shall be hung from the underside of the deck unless specifically indicated thus on the structural drawings. Such items as mechanical/electrical equipment, utility lines, architectural bulkheads, ceilings, signage, etc, shall have their own sub-framing designed, supplied and installed by their related trade, as required span to adjacent beams, joists or walls for any support needed.

3.5 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with Division 01 Section "Structural Testing and Special Inspections".
- B. Inspections:
 - 1. Visually inspect size, location, length and burn-through for 100% of puddle welds on metal deck, per AWS D1.3, Section 6. (Technical I).
 - 2. Visually inspect size, location, and seating for 100% of powder-actuated or pneumatically driven fasteners on metal deck, per AWS D1.3, Section 6. (Technical I).
 - 3. Report inspection results promptly and in writing to Contractor and Architect.
- C. Inspection Procedure:
 - 1. After five to ten squares of roof deck have been erected, arrange for inspection agency to visually inspect fastening system for size, quality and spacing at interior supporting members, perimeter supports and side laps.

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2. Demonstrate corrective procedures for deficiencies found by inspection agency to satisfaction of the Architect and inspection agency before erection of roof deck is resumed.
 3. Use approved fastening system, including corrective procedures, as standard for comparison for remaining deck fastening.
 4. When erection of roof deck is completed, but before placing roofing materials, arrange for inspection agency to make inspection of complete deck installation and submit written report to Architect.
- D. Deck panels shall be clean, dry, and in firm contact with substrate prior to welding.
- E. Remove and replace work that does not comply with specified requirements.
- F. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

END OF SECTION 05 31 23

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**SECTION 054000 – COLD-FORMED
METAL FRAMING**

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. Exterior and interior load-bearing wall framing.
 - 2. Exterior and interior non-load-bearing wall framing.
 - 3. Engineered design by Contractor's Specialty Structural Engineer.
- B. Related Requirements:
 - 1. Division 01 – Structural Testing and Special Inspections.
 - 2. Division 03 – Cast-In-Place Concrete.
 - 3. Division 05 – Structural Steel Framing.
 - 4. Division 05 – Metal Fabrications.
 - 5. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 REFERENCES

- A. AISI – North American Specification for the Design of Cold-Formed Steel Structural Members.
- B. AWS D1.1 – Structural Welding Code.
- C. AWS D1.3
- D. LGSEA's Technical Note 551e, "Design Guide for Permanent Bracing of Cold-Formed Steel Trusses."

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated on drawings
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than indicated on the drawings.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of $L/360$ where L is the span in inches.
- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
 2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Calculations: Include structural analysis data signed and sealed by Qualified Professional Engineer licensed in the State of Minnesota. Submit calculations at the same time as shop drawings.

1.6 INFORMATIONAL SUBMITTALS

- A. Submittal Schedule for all action submittal items.
- B. Welding certificates.
- C. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
 1. Steel sheet.
 2. Expansion anchors.
 3. Power-actuated anchors.
 4. Mechanical fasteners.
 5. Vertical deflection clips.
 6. Horizontal drift deflection clips
 7. Miscellaneous structural clips and accessories.
- D. Research/Evaluation Reports: For cold-formed metal framing.

1.7 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. Professional Engineer Qualifications: A professional engineer who is licensed in the State of Minnesota and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.
- D. Product Tests: Mill certificates or data from a qualified independent testing agency, indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- E. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
 - 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
- H. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."
- I. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AllSteel Products, Inc.
 - 2. Clark Steel Framing.
 - 3. Dale/Incor.
 - 4. Dietrich Metal Framing; a Worthington Industries Company.
 - 5. MarinoWare, a division of Ware Industries.
 - 6. SCAFCO Corporation
 - 7. The Steel Network.
 - 8. Super Stud Building Products, Inc.
 - 9. United Metal Products, Inc.

2.2 MATERIALS

- A. Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: ST33H minimum or as required by structural performance.
 - 2. Coating: G60 or equivalent.
- B. Steel Sheet for Vertical Deflection or Drift Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60.

2.3 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 18 gage (0.0428 inch).
 - 2. Flange Width: Minimum 1-5/8 inches with ½ inch returns.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 18 gage (0.0428 inch).
 - 2. Flange Width: 1-1/4 inches.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 18 gage (0.0428 inch).
 - 2. Flange Width: Minimum 1-5/8 inches with ½ inch returns.

2.4 NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 18 gage (0.0428 inch).
 2. Flange Width: Minimum 1-5/8 inches with ½ inch returns.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 18 gage (0.0428 inch).
 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
1. Available Manufacturers: As per Section 2.1.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
1. Available Manufacturers: As per Section 2.1.
 2. Minimum Base-Metal Thickness: 18 gage or (0.0428 inch).
 3. Flange Width: 1 inch plus twice the design gap.
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

2.5 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers, knee braces, and girts.
 9. Joist hangers and end closures.
 10. Hole reinforcing plates.
 11. Backer plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.
- B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

- C. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 - 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
1. Cut framing members by sawing or shearing; do not torch cut.
 2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- J. At openings in all exterior or bearing walls, provide additional studs as indicated on drawings.
- K. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- 3.4 LOAD-BEARING WALL INSTALLATION
- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
1. Anchor Spacing: As shown on drawings.

- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 - 1. Stud Spacing: 16 inches on center max spacing. Tighten spacing if required for loads.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced as indicated on Shop Drawings. Fasten at each stud intersection.
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated on drawings to support architectural wall finish.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single-leg deflection tracks and anchor to building structure
OR
 - 2. Connect vertical deflection clips to bypassing studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - a. Install solid blocking at centers indicated on Shop Drawings.
 - 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.6 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified special inspector and independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

**SECTION 05 50 00
METAL FABRICATIONS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes shop fabricated metal items.
 - 1. Ledge and shelf angles.
 - 2. Elevator sill angles and hoist beam.
 - 3. Channel door frames.
 - 4. Bollards.
 - 5. Structural supports for miscellaneous attachments.
 - 6. Aluminum louvered screening system at RTU above Stair A

1.2 REFERENCES

- A. Aluminum Association:
 - 1. AA DAF-45 - Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association:
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
 - 2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA 2604 - Voluntary specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

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6. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
7. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
8. ASTM A297/A297M - Standard Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application.
9. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
10. ASTM A312/A312M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
11. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
12. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
13. ASTM A479/A479M - Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
14. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
15. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
16. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
17. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
18. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
19. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings.
20. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings.
21. ASTM B177 - Standard Guide for Chromium Electroplating on Steel for Engineering Use.
22. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
23. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
24. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
25. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
26. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
27. ASTM F436 - Standard Specification for Hardened Steel Washers.

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- 28. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- D. American Welding Society:
 - 1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - 2. AWS D1.1 - Structural Welding Code - Steel.
 - 3. AWS D1.6 - Structural Welding Code - Stainless Steel.
- E. Green Seal:
 - 1. GC-03 - Anti-Corrosive Paints.
- F. National Ornamental & Miscellaneous Metals Association:
 - 1. NOMMA Guideline 1 - Joint Finishes.
- G. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.
 - 2. SSPC SP 1 - Solvent Cleaning.
 - 3. SSPC SP 10 - Near-White Blast Cleaning.
 - 4. SSPC Paint 15 - Steel Joist Shop Paint.
 - 5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.
- C. Samples: Submit illustrating factory finishes.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and reused products.

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- b. Certify recycled material content for recycled content products.
 - c. Certify source for local and regional materials and distance from Project site.
 - d. Indoor Air Quality Certificates:
 - 1) Certify volatile organic compound content for each interior paint and coating.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
 - 1. Provide cost data for the following products:
 - a. Products with recycled material content.
 - b. Local and regional products.

1.5 QUALITY ASSURANCE

- A. Finish joints in accordance with NOMMA Guideline 1.
- B. Sustainable Design Requirements:
 - 1. Recycled Content Materials: Furnish materials with recycled content including per-consumer and post-consumer content whenever possible.
 - 2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site when possible.

1.6 QUALIFICATIONS

- A. Design under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept metal fabrications on site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Plate: ASTM A36/A36M.
- C. Hollow Structural Sections: ASTM A500/A500M, Grade B.
- D. Steel Pipe: ASTM A53/A53M, Grade B Schedule 40.
- E. Sheet Steel: ASTM A653/A653M, Grade 33 Structural Quality, galvanized with G60 coating class.
- F. Bolts: ASTM A325; Type 1.
 - 1. Finish: Unfinished.
- G. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: Unfinished.
- H. Washers: ASTM F436; Type 1.
 - 1. Finish: Unfinished.
- I. Welding Materials: AWS D1.1; type required for materials being welded.
- J. Shop Primer: SSPC Paint 15, Type 1, red oxide.
- K. Touch-Up Primer: Match shop primer.
 - 1. Interior Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03.
- L. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type II Organic.
 - 1. Interior Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03.

2.2 MATERIALS - STAINLESS STEEL

- A. Bars and Shapes: ASTM A276; Type 302.
- B. Tubing: ASTM A269; Type 304.
- C. Pipe: ASTM A312/A312M, seamless; Type 304.
- D. Plate, Sheet and Strip: ASTM A240/A240M OR ASTM 666; Type 304.
- E. Bolts, Nuts, and Washers: ASTM A354.

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- F. Welding Materials: AWS D1.6; type required for materials being welded.

2.3 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 Alloy 6063, Temper T5.
- B. Sheet Aluminum: ASTM B209, Alloy 6063, Temper T5.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210 Alloy 6063, Temper T6.
- D. Aluminum-Alloy Bars: ASTM B211, Alloy 6063, Temper T6.
- E. Aluminum-Alloy Sand Castings: ASTM B26/B26M, Alloy as required to suit application.
- F. Aluminum-Alloy Die Castings: ASTM B85, Alloy as required to suit application.
- G. Bolts, Nuts, and Washers: Stainless steel.
- H. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 LINTELS

- A. Lintels: Steel sections, size and configuration as indicated on Drawings, length to allow 8 inches minimum bearing on both sides of opening.
 - 1. Exterior Locations: Galvanized.
 - 2. Interior Locations: Prime paint, one coat.

2.5 LEDGE AND SHELF ANGLES

- A. Ledge and Shelf Angles, Channels and Plates Not Attached to Structural Framing: For support of metal decking, joists, masonry; prime paint, one coat.

2.6 ELEVATOR SILL ANGLES AND HOIST BEAMS

- A. Sill Angles: Steel sections as indicated on Drawings for support of elevator sills; prime paint, one coat.
- B. Hoist Beams: Steel wide flange sections, shape and size required to support applied loads with maximum deflection of 1/240 of the span; prime paint, one coat.

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2.7 DOOR FRAMES

- A. Door Frames: Steel channel sections, size indicated on Drawings, with jamb anchors suitable for building into masonry, attachment to concrete, steel framing, minimum 4 anchors per jamb; prime paint, one coat.

2.8 BOLLARDS

- A. Bollards: Steel pipe, concrete filled, crowned cap, 8 inches diameter, length as indicated on Drawings; prime paint, one coat.
- B. Concrete Fill: 3,000 psi as specified in Section 03 30 00.
- C. Anchors: Concealed type as indicated on Drawings.

2.9 STRUCTURAL SUPPORTS

- A. Toilet Partition Suspension Members: Steel channel sections; prime paint, one coat.
- B. Other Structural Supports: Steel sections, shape and size as indicated on Drawings; prime paint, one coat.

2.10 ANCHOR BOLTS

- A. Anchor Rods: ASTM F1554; Grade 55, weldable.
 - 1. Shape: Hooked.
 - 2. Furnish with nut and washer; unfinished.

2.11 ALUMINUM LOUVERED SCREENING SYSTEM

- A. Prefinished extruded aluminum posts, aluminum base plates, and extruded aluminum louvered screening panels, utilized as equipment screening at RTU above Stair A. Refer to drawing A522.
- B. Aluminum Louvered Screening System to be the Venetian fixed horizontal louver modular fencing system as manufactured by Ametco Manufacturing Corporation.
 - 1. Ametco Manufacturing Corporation, 4326 Hamann Parkway, P.O. Box 1210, Willoughby, Ohio 44096; 800-362-1360
 - 2. Requests to use equivalent products of other manufacturers shall be submitted in accordance with Section 012500- Products and Substitutions.
 - 3. Venetian: V-shaped louver blade providing 100 percent visual blocking. Modular fence panels fabricated with extruded aluminum framing bars and supported by extruded aluminum fence posts.
- C. Materials:
 - 1. Extruded aluminum: ASTM B221, Alloy 6063, Temper T-6.

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2. Sheet Aluminum: ASTM B209 6063, Temper T-6.
 3. Fixed louver bars: Extruded aluminum louver bars 1 31/32" wide by 2 1/2" high, spaced at 2 5/8" and providing 100 percent direct visual screening.
 4. Framing Bars: Extruded aluminum flat bars welded to ends of louvers.
 5. Fasteners: Stainless steel bolts of type, size, and spacing as recommended by fence manufacturer for specific condition.
- D. Factory Finish:
1. Aluminum fence panels and posts shall receive polyester powder coating: electrostatically applied colored polyester powder coating heat cured to chemically bond finish to metal substrate.
 - a. Minimum hardness measured in accordance with ASTM D3363: 2H
 - b. Direct impact resistance tested in accordance with ASTM D2794. Withstand 160 inch-pounds.
 - c. Weatherability tested in accordance with ASTM D822. No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted at 45 degrees.
- E. Provide shop drawings showing layout, dimensions, spacing of components, and installation details. Mounting plates to be installed prior to roofing activities.
- F. Provide 8"x10" minimum sized sample of fence panel illustrating design, fabrication workmanship, and selected color coating.
- G. Provide copy of warranty with Submittals, and with Close-out documentation.
1. Warranty to include 10 year warranty for factory finish against cracking, peeling, and blistering under normal use.

2.12 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

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- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.13 FACTORY APPLIED FINISHES - STEEL

- A. Prepare surfaces to be primed in accordance with SSPC SP 2.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime paint items with [one coat] [two coats] except where galvanizing is specified.
- D. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication.
- E. Galvanizing for Fasteners, Connectors, and Anchors:
 - 1. Hot-Dipped Galvanizing: ASTM A153/A153M.
 - 2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

2.14 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

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3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.
- C. Field weld components indicated on shop drawings.
- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain approval of Architect/Engineer prior to site cutting or making adjustments not scheduled.
- F. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

3.4 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: 1/4 inch per story or for every 12 ft in height whichever is greater, non-cumulative.
- C. Maximum Offset From Alignment: 1/4 inch.
- D. Maximum Out-of-Position: 1/4 inch.

3.5 FIELD QUALITY CONTROL

- A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION

SECTION 05 51 00

METAL STAIRS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes steel stair frame of structural sections, with closed risers; pan to receive concrete fill stair treads and landings; integral balusters and handrailing.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- B. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 6. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 7. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 8. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - 9. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 - 10. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - 11. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 12. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 13. ASTM F436 - Standard Specification for Hardened Steel Washers.
 - 14. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.

- 15. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
- C. American Welding Society:
 - 1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - 2. AWS D1.1 - Structural Welding Code - Steel.
- D. Green Seal:
 - 1. GC-03 - Anti-Corrosive Paints.
- E. National Association of Architectural Metal Manufacturers:
 - 1. NAAMM AMP 510 - Metal Stairs Manual.
 - 2. NAAMM MBG 531 - Metal Bar Grating Manual.
- F. National Ornamental & Miscellaneous Metals Association:
 - 1. NOMMA Guideline 1 - Joint Finishes.
- G. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.
 - 2. SSPC SP 1 - Solvent Cleaning.
 - 3. SSPC SP 10 - Near-White Blast Cleaning.
 - 4. SSPC Paint 15 - Steel Joist Shop Paint.
 - 5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 DESIGN REQUIREMENTS

- A. Fabricate stair assembly to support uniform live load of 100lb/sq ft and concentrated load of 300 lb/sq ft with deflection of stringer or landing framing not to exceed 1/360 of span.
- B. Railing assembly, wall rails, and attachments to resist lateral force of 75 lbs at any point without damage or permanent set. Test in accordance with ASTM E935.
- C. Fabricate stair assembly to NAAMM AMP 510, Class Commercial.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
- C. Shop Drawings: Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- D. Design Data: Submit design calculations.

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

1.5 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify source and origin for [salvaged] [and] [reused] products.
 - b. Certify recycled material content for recycled content products.
 - c. Certify source for local and regional materials and distance from Project site.
 - 2. Indoor Air Quality Certificates:
 - a. Certify volatile organic compound content for each interior paint and coating.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
 - 1. Provide cost data for the following products:
 - a. Products with recycled material content.
 - b. Local and regional products.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM E985 - Permanent Metal Railing Systems and Rails for Buildings.
- B. Finish joints in accordance with NOMMA Guideline 1.
- C. Sustainable Design Requirements:
 - 1. Recycled Content Materials: Furnish materials with recycled content including pre-consumer and post-consumer content whenever possible.
 - 2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project when possible.

1.7 QUALIFICATIONS

- A. Prepare Shop Drawings under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Plate: ASTM A36/A36M.
- C. Hollow Structural Sections: ASTM A500/A500M, Grade B.
- D. Steel Pipe: ASTM A53/A53M, Grade B Schedule 40.
- E. Sheet Steel: ASTM A653/A653M.
- F. Tread and Landing Concrete Reinforcement: Mesh type as detailed, unfinished.
- G. Bolts: ASTM A325; Type 1.
 - 1. Finish: Unfinished.
- H. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: [Unfinished.] [Hot dipped galvanized.] [Mechanically galvanized.]
- I. Washers: ASTM F436; Type 1.
 - 1. Finish: Unfinished.
- J. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; consistent with design of stair structure.
- K. Welding Materials: AWS D1.1; type required for materials being welded.
- L. Shop Primer: SSPC Paint 15, Type 1, red oxide.
- M. Touch-Up Primer: Match shop primer.
 - 1. Interior Anti-Corrosive Paints: Maximum volatile organic compound content in accordance with GC-03.

- N. Stair Treads: Concrete in metal pan].
- O. Concrete: Type specified in Section 03 30 00.

2.2 FABRICATION

- A. Fit and shop assemble components in largest practical sections, for delivery to site.
- B. Fabricate components with joints tightly fitted and secured.
- C. Continuously seal joined pieces by continuous welds.
- D. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- G. Accurately form components required for anchorage of stairs, landings and railings to each other and to building structure.

2.3 FABRICATION - PAN STAIRS AND LANDINGS

- A. Fabricate stairs and landings with closed risers and treads of metal pan construction, ready to receive concrete.
- B. Form treads and risers with minimum 12 gage sheet steel stock.
- C. Secure [reinforced] tread pans to stringers with clip angles; welded in place.
- D. Form stringers with rolled steel channels, 12 inches deep. Weld fascia plates to channels using 14 gage steel sheet across channel toes.
- E. Form landings with minimum 14 gage sheet stock. Reinforce underside with metal T's to attain design load requirements.
- F. Form balusters with 2 inch diameter steel sections, welded to stringers.

2.4 SHOP FINISHING

- A. Prepare surfaces to be primed in accordance with SSPC SP 2.

- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime paint items with one coat.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive work.
- C. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete and/or embedded in masonry with setting templates.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Install anchors, plates, angles, hangers and struts required for connecting stairs to structure.
- C. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.
- D. Field weld components indicated on shop drawings. Perform field welding in accordance with AWS D1.1.
- E. Field bolt and weld to match shop bolting and welding. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.
- G. Obtain approval of Architect prior to site cutting or creating adjustments not scheduled.

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- H. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- C. Maximum Offset From Alignment: 1/4 inch.

3.5 FIELD QUALITY CONTROL

- A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION

**SECTION 05 51 33.13
METAL LADDERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum Heavy Duty Fixed Vertical Ladders.

1.2 RELATED SECTIONS

- A. Section 05 51 00 – Metal Stairs: Miscellaneous metal supports.
- B. Section 05 50 00 – Metal Fabrications: Roof supports.
- C. Section 07 62 00 – Sheet Metal Flashings and Trim: Parapet flashing.

1.3 REFERENCES

- A. ANSI A14.3: Ladders - Fixed - Safety Requirements.
- B. OSHA 1910.27: Fixed Ladders.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. 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 for Ladders:
 - 1. Plan and section of ladder installation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store product inside under cover until installation. If stored outside, store under a tarp or suitable cover.

1.6 WARRANTY

- A. Limited Warranty: Five years against defective material and workmanship, covering parts only, no labor or freight. Defective parts, if

deemed so by the manufacturer, will be replaced at no charge, freight excluded, upon inspection at manufacturer's plant which warrants same.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Precision Ladders, LLC, which is located at: P.O. Box 2279 ; Morristown, TN 37816-2279; Toll Free Tel: 800-225-7814; Tel: 423-586-2265; Email: info@PrecisionLadders.com; Web: www.PrecisionLadders.com
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 ALUMINUM FIXED VERTICAL LADDER

- A. Aluminum Fixed Vertical Ladder and Components: Ladder, cage, rest platforms, floor mounting brackets, security doors, walk-thru, and side rails.
 - 1. Model: Model FL -*** (***= vertical height in inches – verify before ordering) Aluminum Fixed Vertical Ladder as manufactured by Precision Ladders LLC.
 - 2. Capacity: Unit shall support a 1000 lb (454 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. Security Door: 0.125 inch (3 mm) 3003-H14 aluminum panel 84 inches (2134 mm) tall with padlock provision.

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- 6. Floor Brackets: Floor bracket at foot of each stringer, 3 by 2 by 1/4 inch (76 by 51 by 6 mm).
- 7. Finishes:
 - a. Standard: Mill finish on aluminum ladder components.

2.3 FABRICATION

- A. Completely fabricate ladder ready for installation before shipment to the site.
- B. Completely fabricate handrail components ready for field assembly to ladder before shipment to site.

PART 3 EXECUTION

3.1 EXAMINATION

- A. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- B. Examine materials upon arrival at site. Notify the carrier and manufacturer of any damage.

3.2 INSTALLATION

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

3.3 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

**SECTION 05 52 00
HANDRAILS AND RAILINGS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Steel pipe handrails, guardrails, balusters, and fittings.

1.2 REFERENCES

- A. ASTM A501 – Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- B. SSPC - Steel Structures Painting Council.

1.3 DESIGN REQUIREMENTS

- A. Railing assembly, wall rails, and attachments to resist lateral force of 75 lbs at any point without damage or permanent set.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1.5 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 STEEL RAILING SYSTEM

- A. Steel Tubing: ASTM A501.
- B. Posts: 1-1/2 inch diameter steel tubing; welded joints.
- C. Fittings: Elbows, T-shapes, wall brackets, escutcheons; machined steel.
- D. Wall Brackets: 1/4 inch formed steel handrail brackets, 3 inch center, 2 mounting holes, round top, square style, as manufactured by R & B Wagner, Inc.

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- E. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
- F. Splice Connectors: Steel welding collars.
- G. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide.

2.2 FABRICATION

- A. Fit and shop assemble components in largest practical sizes, for delivery to site.
- B. Fabricate components with joints tightly fitted and secured.
- C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- E. Continuously seal joined pieces by continuous welds.
- F. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- G. Accurately form components to suit stairs and landings, to each other and to building structure.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate Sections.

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3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates required for connecting railings to structure. Anchor railing to structure.
- C. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.
- D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.4 ERECTION TOLERANCES

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

END OF SECTION

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**SECTION 057313 -GLAZED
DECORATIVE METAL RAILINGS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes stainless steel post supported railing systems with glass infill.

1.3 REFERENCES

- A. American National Standards Institute (ANSI) Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings.
- B. ASTM International (ASTM):
 - 1. A240/A240M – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
 - 3. C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT, Coated and Uncoated Glass.
 - 4. E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
- C. National Association of Architectural Metal Manufacturers (NAAMM) AMP 503 - Finishes for Stainless Steel.

PERFORMANCE REQUIREMENTS

- A. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stress of materials for handrails, railings, anchors, and connections:
 - 1. Top of Guardrails: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf applied at any point and in any direction.
 - b. Uniform load of 50 lbf / ft. applied horizontally and concurrently with uniform load of 100 lbf / ft. applied vertically downward.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Handrails: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated load of 200 lbf applied at any point and in any direction.
 - b. Uniform load of 50 lbf / ft. applied in any direction.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
 3. Infill Area of Guards: Capable of withstanding a horizontal concentrated load of 200 lbf applied to 1 sq. ft. at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
 - a. Load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.
 4. Design in accordance with applicable OSHA requirements
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
1. Stainless Steel: 60 percent of minimum yield strength.
 2. Steel: 72 percent of minimum yield strength.
 3. 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. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation of handrails and railings. Include plans, elevations, sections, details, and attachments to other Work.
1. For installed handrails and railings indicated to comply with design loads, include structural analysis data signed and sealed by Professional Structural Engineer licensed in State in which project is located.
- B. Samples for Verification: For each type of exposed finish required, prepared on components indicated below and of same thickness and metal indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
1. 12-inch-long sections of each different linear railing member, including handrails, top rails, posts, and balusters.
 2. Fittings and brackets.
 3. Assembled Samples of railings, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.
- C. Product Test Reports: Indicating products comply with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum two (2) years documented experience in work of this Section.

- B. Source Limitations: Obtain each type of railing through one source from a single manufacturer.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.6, "Structural Welding Code - Stainless Steel."
- E. 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.
- F. Mockups: Before installing handrails and railings, build mockup to demonstrate aesthetic effects and qualities of materials and execution. Mockup to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockup in the location indicated or, if not indicated, as directed by Architect.
 - 2. Build mockups as shown on Drawings.
 - 3. Build mockups for each form and finish of railing consisting of two posts, handrail, infill area, and anchorage system components that are full height and are not less than 48 inches in length.
 - 4. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 5. Obtain Architect's approval of mockups before fabricating ornamental handrails and railings.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed.
 - 8. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- G. Pre-Installation Conference:
 - 1. Convene pre-installation conference approximately two weeks prior to beginning work of this Section.
 - 2. Attendance: Construction Manager, Architect, railing fabricator, and railing installer.
 - 3. Review:
 - a. Installation methods for frame components attaching to supporting construction.

- b. Installation, adjusting, and protection of railing system.
- c. Coordination with other work.

1.6 STORAGE

- A. Store handrails and railings in a dry, well-ventilated, weathertight place.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 COORDINATION

- A. Coordinate installation of anchorages for handrails and railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.9 SCHEDULING

- A. Schedule installation so handrails and railings are mounted only on completed work. Do not support temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Binzel Industries, Inc.
 2. Blum, Julius & Co., Inc.
 3. Blumcraft of Pittsburgh.
 4. Livers Bronze Co.
 5. P & P Artec
 6. VIVA Railings, LLC
 7. Wylie Systems.

2.2 METALS

- A. General: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.
- A. Stainless Steel:
 1. Bars and Shapes: ASTM A276, Type 304 or 316.
 2. Tube: ASTM A554, Type 304 or 316.
 3. Castings: ASTM A743, Grade CF8 or CF20.

4. Sheet, Strip, Plate and Flat Bar: ASTM A666, Type 304 or 316.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.
 1. Provide formed steel brackets with predrilled hole for bolted anchorage.

2.3 GLASS PRODUCTS AND GLAZING MATERIALS

- A. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent glass, flat), Quality q3 (glazing select). Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR, Part 1201 for Category II materials.
 1. Thickness for Glass Infill Panels: As required by structural loads, but not less than 10.0 mm.
- B. Glazing Accessories: Provide glazing accessories recommended or supplied by railing manufacturer.

2.4 FASTENERS

- A. Fasteners for Anchoring Handrails and Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring handrails and railings to other types of construction indicated and capable of withstanding design loads.
 1. Where exposed, use fasteners fabricated from Type 304 or Type 316 stainless steel.
- B. Fasteners for Interconnecting Handrail and Railing Components: Use fasteners fabricated from same basic metal as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
 1. Provide countersunk fasteners for interconnecting railing components and for attaching them to other Work, unless otherwise indicated.
- C. Cast-in-Place and Postinstalled Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
 1. Cast-in-place anchors.
 2. Chemical anchors.
 3. Expansion anchors.

2.5 FABRICATION

- A. Assemble handrails and railings in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- B. Components:
 1. Posts: 1/2 inch to 1 inch bar.

2. Handrails: 1.5 inch diameter stainless steel round tubing.
 3. Glass mountings: Stainless steel, clip type.
 4. Mounting method: Fascia.
- C. Fabricate railings in accordance with approved Shop Drawings.
 - D. Fabricate railings with joints located symmetrically.
 - E. Fabricate railings with joints tightly fitted and secured. Furnish fittings to accommodate site assembly and installation.
 - F. Supply components required for anchorage of railings. Fabricate anchors and related components of same material and finish as railing.
 - G. Conceal fastenings where possible.
 - H. Use welds for permanent connections where possible.
 1. Grind exposed welds smooth.
 2. Tack welds prohibited on exposed surfaces.
 - I. Accommodate for expansion and contraction of members and building movement without damage to connections or members.
 - J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to connect handrail and railing members to other construction.
 - K. Provide anchorage devices to connect handrails and railings to concrete. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.
 - L. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.
 - M. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
 - N. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

2.6 GLAZING PANEL FABRICATION

- A. Glass Panels: Cut tempered glass to final size and shape before heat treatment; provide for proper edge clearance and bite on glass. Provide thickness indicated, but not less than that required to support structural loads.
- B. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.

2.7 FINISHES, GENERAL

- 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: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. 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.

2.8 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Directional Satin Finish: No. 4: Grind and polish surfaces to produce uniform finish, free of cross scratches. Run grain of directional finishes with long dimension of each piece.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing handrails and railings. Set handrails and railings accurately in location, alignment, and elevation, measured from established lines and levels and free from 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. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust handrails and railings before anchoring to ensure alignment at abutting joints. Space posts at interval indicated, but not more than that required by structural loads.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.

3.2 INSTALLING GLASS PANELS

- A. Post-Supported Glass Handrails and Railings: Install assembly to comply with railing manufacturer's written instructions. Erect posts and other metal railing components, then set factory-cut glass panels. Do not cut, drill, or alter glass panels in field. Protect edges from damage.

3.3 CLEANING

- A. Clean and polish glass.

3.4 PROTECTION

- A. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the 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 field to shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057313

SECTION 05 73 16

CABLE RAILING

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Fabricate and install metal cable assemblies in accordance with the requirements set forth in this section.

1.2 ADDITIONAL WORK INCLUDED IN THIS SECTION

- A. Field measuring for weld plates, sleeves, and insert locations.
- B. Field measuring.
- C. Anchors or inserts for precast concrete.
- D. Prime painting of galvanized materials
- E. The following items are not to be included in the metal rail contractor's work:
 - 1. Temporary shoring or bracing
 - 2. Cleanup of existing construction prior to installation of panels
 - 3. Cutting; preparation of pockets; setting of plates, inserts, carpenter hardware or any other built-ins
 - 4. Temporary lights and electricity
 - 5. Temporary safety rails after erection
 - 6. Field painting
 - 7. Final cleaning and protection of aluminum, stainless steel, bronze and glass

1.1 REFERENCES

- A. American Institute of Steel Construction (AISC)
 - 1. Manual of Steel Construction
- B. American Iron and Steel Institute (AISI)
 - 1. Steel Products Manual; Stainless and Heat Resisting Steel.
 - 2. Code of Standard Practice
- C. American National Standards Institute (ANSI)
 - 1. ANSI A21.1 Safety Requirements for Floor and Wall Openings, Railings and Toe Boards.
 - 2. ANSI A58.1 Minimum Design Loads in Buildings and Other Structures.
 - 3. ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities.

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4. ANSI A97.1 Safety Performance Specifications and Methods of Test for Safety Glazing Material used in Buildings.
- D. American Society for Testing and Materials (ASTM)
 1. A 36 Carbon Structural Steel.
 2. A 47 Specification for Ferritic Malleable Iron Castings.
 3. A 123 Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
 4. A1264-1 Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railing Systems
 5. E 84 Test Method for Surface Burning Characteristics of Building Materials.
 6. E 894 Standard Test Methods for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
 7. E 935 Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
 8. E 985 Specification for Permanent Metal Railing Systems and Rails for Buildings.
- E. American Welding Society (AWS)
 1. Specifications for Welding Rods and Bare Electrodes.
- F. Americans With Disabilities Act Accessibility Guidelines (ADAAG)
- G. General Service Administration (GSA) Federal Specifications (FS)
 1. FS-TT-P-641 Primer Coating, Zinc Dust/Zinc Oxide (for Galvanized Surfaces).
 2. FS-TT-P-645 Primer, Paint, Zinc Chromate, Alkyd Type.
 3. FS-TT-P-645A Primer, Paint, Zinc Chromate, Alkyd Type.
- H. International Code Council (ICC)
 1. International Building Code (IBC)
- I. Iron and Steel Society (ISS)
 1. Steel Products Manual
 - a. Sheet Steel
 - b. Stainless and Heat Resisting Steels
- J. National Association of Architectural Metal Manufacturers (NAAMM) and National Ornamental and Miscellaneous Metals Association (NOMMA)
 1. Metal Finishes Manual
- K. National Association of Architectural Metal Manufacturers (NAAMM)
 1. Pipe Railing Manual
 2. Metal Stair Manual
- L. National Association of Home Builders' Research Center (NAHBRC)

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1. Review of Fall Safety of Children Between the Ages of 18 Months and 4 Years in Relations to Guards and Climbing in the Built Environment.
- M. National Fire Protection Association (NFPA)
 1. 101 Life Safety Code
- 1.2 REGULATORY REQUIREMENTS
 1. Components and installation are to be in accordance with state and local code authorities
 2. Components and installation are to follow current ADA and ICC/ANSI A117.1 guidelines.
- B. Certifications
 1. Furnish certification that all components and fittings are furnished by the same manufacturer or approved by the primary component manufacturer.
 2. Furnish certification that components were installed in accordance to the manufacturer's engineering data to meet the specified design loads.
- 1.3 STRUCTURAL REQUIREMENTS
 - A. Cable assembly frame components and cable hardware shall be designed to withstand loads encountered without excessive deflection or distortion when cables are tensioned to conform to building code requirements.
- 1.4 SUBMITTALS
 - A. Submit shop drawings and product data under provisions of Section 01 33 00.
 1. Show sections and plans of panels, dimensions and assembly of components.
 - a. Reinforcements
 - b. Anchors
 - c. Bolted connections
 2. Show all field connections
 3. Provide setting diagrams for installation of anchors and location of fasteners for attachment of cables to structure.
 4. Indicate all required field measurements.
 5. Submit one (1) set of CAD drawings for approval.
 - B. Indicate component details, materials, finishes, connection and joining methods, and the relationship to adjoining work.
 - C. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

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- D. Samples:
 - 1. Submit duplicate samples of cable assembly components showing style and finish. One approved sample will be returned to contractor.
 - 2. Certificates:
 - a. Furnish manufacturer's certification that materials meet specification requirements.
- E. Substitutions:
 - 1. Any changes in specified material must meet requirements of the General Conditions "or equal" clause. See Special Conditions Section 3, Paragraph 14 – Trade Names and Materials.
 - 2. Changes in architectural details to fabricator's standard procedures will be allowed when appearance and strength are not affected.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications:
 - 1. Furnish references listing projects of similar size and scope.
 - 2. For installed cable railing systems indicated to comply with certain design loadings, include structural analysis data signed and sealed by the professional engineer who was responsible for their preparation.
- B. Installer Qualifications
 - 1. Submit documentation demonstrating capability and experience in performing installations of the same type and scope as specified by this Section.
- C. Pre-Installation Meeting
 - 1. Prior to the beginning of work, conduct a pre-job conference at the job site.
 - 2. Provide seven calendar days advance written notice ensuring the attendance by competent authorized representatives of the fabricator, building owner's representative, architect and subcontractors whose work interfaces with the work of this section.
 - 3. Review the specifications to determine any potential problems, changes, scheduling, unique job site conditions, installation requirements and procedures and any other information pertinent to the installation.
 - 4. Record the results of the conference and furnish copies to all participants.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.

- B. Storage on site:
 - 1. Store material in a location and in a manner to avoid damage.
 - 2. Store material in a clean, dry location away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.
 - 3. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of material.

1.7 SUSTAINABILITY REQUIREMENTS:

- A. Submittals: Submittals that are required to comply with requirements for sustainability certification include, but shall not be limited to, the following:
 - 1. Recycled Content: Provide product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.
 - 2. Regional Materials: Provide product data for regional materials indicating location and distance from the Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Distance shall be within 500 miles (805 Km) of the Project Site.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Cable and accessories shall be as manufactured or supplied by Tyler Madison, Inc., 6950 W. 146th St., Suite 120, Apple Valley, MN 55124. Phone: 888-638-3604. Fax: 952-431-2225. Web site: www.tylermadison.com . Email at sales@tylermadison.com
- B. Substitutions: Under provisions of Section 01 60 00.

2.2 MATERIALS AND FINISHES

- A. Cable:
 - 1. Type: 3/8 inch 7 x 19
 - 2. U.S. Federal Specification RR-W-410D, Type VI, Class 3
 - 3. Material: Galvanized steel.
- B. Accessories:
 - 1. Clamps:
 - a. Type: U-bolt
 - b. Size 3/8 inch
 - c. Material: Galvanized steel.
 - 2. Thimbles:
 - a. Size 3/8 inch, Regular Duty
 - b. U.S. Federal Specification FF-T-276b, Type II

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- c. Material: Galvanized steel.
- 3. Eyebolts:
 - a. Forged machinery eye bolt
 - b. Size 9/16-12 x 1-5/8
 - c. Material: Zinc plated steel
- 4. Intermediate Cable Braces:
 - a. Type: Single piece.
 - b. Size: 1/4" x 1".
 - c. Spacing: Evenly spaced, maximum 42" on center.
 - d. Material: Cold formed steel.

- 5. Cable Grommets:
 - a. Material: Ultraviolet-resistant Delrin or equivalent.
 - b. Prevent abrasion of intermediate posts, end posts, and cable braces bored for cables.
 - c. Color: Black.

2.3 CABLE ASSEMBLY SYSTEM

- A. Material shall conform to 2.2 and be finished in accordance with 2.2.
- B. Horizontal galvanized steel cable.
- C. Mounting: As indicated on drawings.
- D. Cables:
 - 1. Orientation: Horizontal.
 - 2. Spacing: Maximum 3.36 inches on center.
- E. Cable Hardware Accessories:
 - 1. Type: Use most economical combinations of fittings practical.

2.4 FASTENERS

- A. All mechanical fasteners used in the assembly of galvanized steel cable railings shall be manufactured from steel with a zinc coating or galvanized finish.

2.5 FABRICATION

- A. Form frame corners by miter elbows.
- B. Cut material square and remove burrs from all exposed edges, with no chamfer.
- C. Make exposed joints butt tight and flush.
- D. Verify dimensions on site prior to shop fabrication.

PART 3 EXECUTION

3.1 PREPARATION

- A. Supply items to be embedded in precast concrete.
- B. Examine areas to receive cable assembly. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with shop drawings and manufacturer's instructions at locations indicated on the drawings.
- B. Install cables parallel to slope of floor, rigid, and free from distortion or defects detrimental to appearance or performance.
- C. Anchor cable assembly to mounting surface as indicated on the drawings.
- D. Use manufacturer-supplied cable hardware.
- E. Terminate and tension cables in accordance with manufacturer's instructions.
- F. Tension cables to a minimum of 400 pounds each in sequence in accordance with manufacturer's instructions.
- G. Ensure cables are clean, parallel to each other and without kinks or sags.
- H. Adjust cables and cable hardware as required to provide properly installed cable railing system as directed by Architect.
- I. Expansion joints shall be provided as needed to allow for thermal expansion or contraction.

3.3 PROTECTION

- A. Protect cable railing system and finish from damage during construction.

3.4 CLEANING

- A. As installation is completed, wash thoroughly using clean water and soap; rinse with clean water.
- B. Do not use acid solution, steel wool or other harsh abrasives.
- C. If stain remains after washing, remove finish and restore in accordance with NAAMM/NOMMA Metal Finishes Manual.

3.5 REPAIR OF DEFECTIVE WORK

- A. Remove stained, corroded or otherwise defective work and replace with material that meets specification requirements.
- B. Repair damaged finish as directed by Architect
- C. Replace defective or damaged components as directed by Architect.

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END OF SECTION

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SECTION 05 75 12

WIRE CLOTH

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes wire cloth and accessories.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 4. ASTM F436 - Standard Specification for Hardened Steel Washers.
- B. American Welding Society:
 - 1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - 2. AWS D1.1 - Structural Welding Code - Steel.
- C. Green Seal:
 - 1. GC-03 - Anti-Corrosive Paints.
- D. National Ornamental & Miscellaneous Metals Association:
 - 1. NOMMA Guideline 1 - Joint Finishes.
- E. SSPC: The Society for Protective Coatings:
 - 1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Product Data for wire cloth.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

- D. Samples: Submit illustrating factory finishes.
- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify recycled material content for recycled content products.
 - b. Certify source for local and regional materials and distance from Project site.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
 - 1. Provide cost data for the following products:
 - a. Products with recycled material content.
 - b. Local and regional products.

1.5 QUALITY ASSURANCE

- A. Finish joints in accordance with NOMMA Guideline 1.
- B. Sustainable Design Requirements:
 - 1. Recycled Content Materials: Furnish materials with recycled content including pre-consumer and post-consumer.
 - 2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site when possible.

1.6 QUALIFICATIONS

- A. Design under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept metal fabrications on site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Direct Metals Company, 3775 Cobb International Blvd., Kennesaw, GA 30152-4390. Phone: (800) 711-4939, Fax: (770) 528-9002, www.directmetals.com, info@directmetals.com
- B. Ametco® Manufacturing Corporation, 4326 Hamann Parkway, P.O. Box 1210, Willoughby, OH 44096; (800) 362-1360.
- C. Requests to use equivalent products of other manufacturers shall be submitted in accordance with Section 01 60 00.

2.2 WIRE MESH

- A. Material: Galvanized Steel.
- B. Type: Woven wire cloth fabricated from 0.120 inch (3.048 mm) diameter wire woven into a square mesh with 1 inch (25.4 mm) opening between wires, welded and galvanized.

2.3 ACCESSORIES

- A. U-Edging as manufactured by Direct Metals Co.
 - 1. Material: Galvanized Steel.
 - 2. Type: Channel fabricated from 18 gauge carbon steel into a u-shaped form, 1 inch (25.4 mm) wide with 0.125 inch (3.175 mm) inside opening, galvanized.
- B. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type II Organic.

2.4 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish.

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- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.5 FACTORY APPLIED FINISHES - STEEL

- A. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication.
- B. Galvanizing for Fasteners, Connectors, and Anchors:
 - 1. Hot-Dipped Galvanizing: ASTM A153/A153M.
 - 2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

2.6 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

- A. Supply fasteners required to be drilled and grouted/epoxied into concrete.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.

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- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.
- C. Obtain approval of Architect/Engineer prior to site cutting or making adjustments not scheduled.
- D. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

END OF SECTION

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**SECTION 061000 - ROUGH
CARPENTRY**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. This section includes the following:
 - 1. Wood blocking, cants and nailers.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 7 Section 075323 "EPDM Roofing."

1.3 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other sections and generally not exposed, unless otherwise specified.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee's (ALSC) Board of Review.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.
 1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Wood-Preservative-Treated Materials:
 - A. Baxter: J. H. Baxter Co.
 - B. Chemical Specialties, Inc.
 - C. Continental Wood Preservers, Inc.
 - D. Hickson Corp.
 - E. Hoover Treated Wood Products, Inc.
 - F. Osmose Wood Preserving, Inc.

2.2 LUMBER, GENERAL

- A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
 1. SPIB - Southern Pine Inspection Bureau.
 2. WWPAA - Western Wood Products Association.

3. NELMA - Northeastern Lumber Manufacturers Association.

- C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
- D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 1. Provide dressed lumber, S4S, unless otherwise indicated.
 - 2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPAC2 (lumber) and AWPAC9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
 - 1. Do not use chemicals containing chromium or arsenic.
- B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
- C. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPAC4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.
- D. Do not use oil borne pentachlorophenol for surfaces that are to be painted and surfaces in contact with roofing.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

- D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of Southern pine-SPIB or Douglas fir south-WWPA, unless otherwise indicated.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A153 or of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers.

2.6 MISCELLANEOUS MATERIALS

- A. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- B. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum number of joints or optimum joint arrangement.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- D. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

- E. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. "Recommended Nailing Schedule" of referenced framing standard and with AFPA's "National Design Specifications for Wood Construction." Comply with requirements of applicable codes and of authorities having jurisdiction.
- G. Use hot-dip galvanized nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

3.2 WOOD BLOCKING AND NAILERS

- A. Install wood blocking and nailers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
- C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

END OF SECTION 061000

SECTION 07 13 00

SHEET MEMBRANE WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. The work of this section includes, but is not limited to, the following:
 - 1. Rubberized asphalt sheet membrane waterproofing
 - 2. Prefabricated drainage composite
 - 3. Protection board

1.2 REFERENCE STANDARDS

- A. The following standards and publications are applicable to the extent referenced in the text.
- B. American Society for Testing and Materials (ASTM)
 - 1. C 836 Standard Specification for High Solids, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
 - 2. D 412 Standard Test Methods for Rubber Properties in Tension
 - 3. D 570 Standard Test Method for Water Absorption of Plastics
 - 4. D 882 Standard Test Methods for Tensile Properties of Thin Plastic Sheetings
 - 5. D 903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
 - 6. D 1876 Standard Test Method for Peel Release of Adhesives (T-Peel)
 - 7. D 1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
 - 8. D 3767 Standard Practice for Rubber - Measurements of Dimensions
 - 9. D 5385 Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
 - 10. E 96 Standard Test Methods for Water Vapor Transmission of Materials
 - 11. E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations. Include certification of data indicating VOC (Volatile Organic Compound) content of all components of waterproofing system.
- B. Samples: Submit representative samples of the following for approval:
 - 1. Sheet membrane
 - 2. Protection board
 - 3. Prefabricated drainage composite

1.4 QUALITY ASSURANCE

- A. Manufacturer: Sheet membrane waterproofing shall be manufactured and marketed by a firm with a minimum of 20 years experience in the production and sales of self-adhesive sheet membrane waterproofing. Manufacturers proposed for use but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past 5 years.
- B. Installer: A firm which has at least 3 years experience in work of the type required by this section.
- C. Materials: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer.
- D. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.
 - 1. Do not double-stack pallets of membrane on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
 - 2. Protect mastic and adhesive from moisture and potential sources of ignition.
 - 3. Store drainage composite or protection board flat and off the ground. Provide cover on top and all sides.

- B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.6 PROJECT CONDITIONS

- A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.
- B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.7 WARRANTY

- A. Sheet Membrane Waterproofing: Provide written 5 year material warranty issued by the membrane manufacturer upon completion of the work.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Sheet Membrane Waterproofing: Bituthene® 3000/Low Temperature Membrane by Grace Construction Products; a self-adhesive, cold-applied composite sheet consisting of a thickness of 1.4 mm (0.056 in.) of rubberized asphalt and 0.1 mm (0.004 in.) of cross-laminated, high density polyethylene film. Provide rubberized asphalt membrane covered with a release sheet, which is removed during installation. No special adhesive or heat shall be required to form laps.
- B. Prefabricated Drainage Composite: Hydroduct® 220 Drainage Composite by Grace Construction Products. Drainage Composite shall be designed to promote positive drainage while serving as a protection course.
- C. Protection Board:
 - 1. Expanded Polystyrene Protection Board: 25 mm (1 in.) thick for vertical applications with the following characteristics. Adhere to waterproofing membrane with Bituthene Protection Board Adhesive.
 - a. Normal Density: 16 kg/m³ (1.0 lb/ft³)
 - b. Thermal Conductivity, K factor: 0.24 at 5°C (40°F), 0.26 at 24°C (75°F)
 - c. Thermal Resistance, R-Value: 4 per 25 mm (1 in.) of thickness.
- D. Miscellaneous Materials: Surface conditioner, mastic, liquid membrane, tape and accessories specified or acceptable to manufacturer of sheet membrane waterproofing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 PREPARATION OF SUBSTRATES

- A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.
- B. Masonry Substrates: Apply waterproofing over concrete block and brick with smooth trowel-cut mortar joints or parge coat.
- C. Related Materials: Treat joints and install flashing as recommended by waterproofing manufacturer.

3.3 INSTALLATION

- A. Refer to manufacturer's literature for recommendations on installation, including but not limited to, the following:
 - 1. Apply primer at rate recommended by manufacturer. Recoat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of primer.
 - 2. Delay application of membrane until primer is completely dry. Dry time will vary with weather conditions.
 - 3. Seal daily terminations with troweled bead of mastic.
 - 4. Apply protection board and related materials in accordance with manufacturer's recommendations.

3.4 CLEANING AND PROTECTION

- A. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work.
- B. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

END OF SECTION

SECTION 07 18 16

VEHICULAR TRAFFIC COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Installation of waterproof polyurethane traffic coating on surfaces indicated on drawings, consisting of preparation of existing and repaired concrete surfaces, sealing of cracks and joints and application of CCW-5123 Deck Coating System.

1.2 REFERENCES

- A. ASTM C957 High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Integral Wearing Surface.

1.3 SYSTEM DESCRIPTION

- A. Product provided by this Section is a system of compatible polyurethane deck coatings designed to create a seamless waterproofing membrane and suitable for use as a wearing surface on vehicular traffic decks.

1.4 SUBMITTALS

- A. General: Submit in accordance with Section 01 30 00.
- B. Product Data: Submit manufacturer's product literature and installation instructions.
- C. Samples: Submit cured samples of specified system showing the approximate applied thickness, texture and color.
- D. Subcontractor's approval by manufacturer: Submit document stating manufacturer's acceptance of subcontractor as an approved applicator for the specified materials.
- E. Warranty: Submit a sample warranty identifying the terms and conditions stated in Section 1.7.

- F. Maintenance Manual: Upon completion of the work required by this section, submit one Maintenance Manual, including recommendations for periodic inspections, care, maintenance and repair of damage.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Applicator shall be experienced in applying the same or similar materials and shall be specifically approved in writing by the coating system manufacturer.
- B. Regulatory Requirements: Comply with applicable codes, regulations, ordinances and laws regarding use and application of coating systems that contain volatile organic compounds (VOCs).
- C. Pre-Application Conference: Prior to beginning work, convene a conference to review conditions, installation procedures, schedules and coordination with other work.

1.6 WARRANTY

- A. Upon completion and acceptance of the work required by this section, the installation shall be warranted, on a single document, by the Manufacturer and the applicator.
- B. The installation shall be warranted against loss of waterproofing integrity, adhesive or cohesive failure and coating cracks as a result of cracks in the substrate up to 1/16 inch width.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original, factory-sealed, unopened containers bearing manufacturer's name and label intact and legible with following information:
 - 1. Name of material
 - 2. Manufacturer's stock number and date of manufacture
 - 3. Material safety data sheet
- B. Recommended storage and application temperature is 75°F. Store materials in protected and well-ventilated area.

1.8 PROJECT CONDITIONS

- A. Do not apply coating materials if temperature is less than 40° F or if precipitation is imminent.
- B. Coordinate deck coating work with other trades to ensure adequate illumination, ventilation and a dust-free environment during application and curing of deck coatings. The applicator shall have sole right of access to the specified areas for the time needed to complete the application and allow the coating to cure adequately.
- C. Protect adjoining surfaces not to be coated against damage or soiling. Protect plants, vegetation and animals that might be affected by coating operations.
- D. Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.
- E. Take care to keep vapors from entering occupied structures. Turn off intake blowers, seal doors, vents and other openings that could allow vapors to enter.
- F. Keep products away from spark or flame. Do not allow the use of spark-producing equipment during application, or until all vapors have dissipated. Post NO SMOKING signs.
- G. Maintain work area in a neat and orderly condition, removing empty containers, rags and rubbish daily from the site.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide CCW-5123 Deck Coating System as manufactured by Carlisle Coatings and Waterproofing, Incorporated, 900 Hensley Lane, Wylie, Texas 75098, Phone: (800) 527-7092, Fax: (972) 442-0076.
- B. Substitutions: Under the provisions of Section 01 60 00.

2.2 PRODUCTS

- A. Base Membrane: Shall be CCW-501 single-component, VOC-compliant, high-adhesion, liquid polyurethane membrane and shall meet or exceed the following typical performance properties:
1. Property Typical Value ASTM Method
 2. Composition Aromatic Urethane
 3. Solids by Weight 85% C1250
 4. Hardness, Shore A 63 D2240
 5. Tensile Strength 850 PSI D412
 6. Ultimate Elongation 625% D412
 7. Tear Resistance 140 lb/in D624
 8. Adhesion to Concrete 23 PLI D903
 9. Low Temp Flexibility -65°F D522

- B. Elastomeric Membrane: Shall be CCW-502 single-component, VOC-compliant, high-tensile strength, liquid-applied, elastomeric polyurethane and shall meet or exceed the following typical performance properties:
1. Property Typical Value ASTM Method
 2. Composition Aromatic Urethane
 3. Solids by Weight 80% C1250
 4. Hardness, Shore A 82 D2240
 5. Tensile Strength 2000 PSI D412
 6. Ultimate Elongation 425% D412
 7. Tear Resistance, Die C 300 lb/in D624
 8. Low Temp Flexibility -65°F D522
- C. Traffic-Resistant Top Coat: Shall be CCW-503 single-component, VOC-compliant, high-tensile strength, abrasion-resistant and weather-resistant, aliphatic elastomeric polyurethane and shall meet or exceed the following typical performance properties:
1. Property Typical Value ASTM Method
 2. Composition Aliphatic Urethane
 3. Solids by Weight 72% C1250
 4. Hardness, Shore A 91 D2240
 5. Tensile Strength 3200 PSI D412
 6. Ultimate Elongation 190% D412
 7. Tear Resistance, Die C 300 lb/in D624
 8. Low Temp Flexibility Pass C957
 9. Crack Bridging – Deck Coating System
 10. Weather Resistance No Chalking at 2000 hrs G53
 11. Water Permeability (system) < 1.0 Perm E96 B
 12. Abrasion Resistance (system) < 50 mg C501

13. Fire Resistance (system) Class A UL 790

2.3 ACCESSORY PRODUCTS

- A. Surface Primer: Shall be CCW-557 two-component epoxy primer or as recommended by manufacturer for each surface encountered.
- B. Detail Coat: Shall be CCW-501-T single-component, moisture-cured polyurethane membrane.
- C. Aggregate: Shall be clean, dry, 16 to 30 mesh aggregate as approved by the coating manufacturer.
- D. Sealants: Shall be one-component approved sealant by CCW or CCW-201 two-component Polyurethane Sealant.
- E. Backing Rod: Shall be closed-cell polyethylene foam rod.
- F. Flexible Flashing: Shall be as recommended and supplied by coating manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

- A. Before any waterproofing work is started, the waterproofing applicator shall thoroughly examine all surfaces for any deficiencies. Should any deficiencies exist, the architect, owner or general contractor shall be notified in writing and corrections made.
- B. Condition of Concrete Surfaces:
 - 1. The concrete surfaces shall be of sound structural grade (minimum of 3500 PSI compressive strength for vehicular decks), and shall have a steel-troweled followed by a fine-broom finish, free of fins, ridges, voids or entrained air holes.
 - 2. Concrete shall be cured by water curing method. Curing compounds must be of the pure sodium silicate type and be approved by the Carlisle representative.
 - 3. Concrete shall be cured at least 28 days and shall be sloped for proper drainage.

4. Saw-cut control joints and/or expansion joints shall have been properly installed at strategic points throughout the field of the deck to control cracking caused by deflection and shrinkage.
5. Any required crickets or drains should be installed at the time the main deck is poured. Deck should be monolithic.
6. Voids, rock pockets and excessively rough surfaces shall be repaired with approved non-shrink grout or grout to match the unrepaired areas.
7. When metal decking is used as the concrete form, it shall be of the ventilated type.
8. All concrete decks poured over precast "Tees", planks or slabs shall have control joints placed directly over all corresponding joints or openings in the precast units.

3.2 SURFACE PREPARATION

A. Concrete Surfaces:

1. The concrete surface must be thoroughly clean, dry and free from any surface contaminants or cleaning residue. Acceptable methods of cleaning are vacuum shotblasting, sandblasting, acid etching or mechanical grinding, followed by the complete and thorough removal of any residue.
2. Install a 1 inch face, 45° cant of an approved sealant by CCW or CCW-201 polyurethane sealant at all angle changes, including projections through the deck, walls, curbs, bumpers, etc.

3. All cracks over 1/16 inch width and all moving cracks under 1/16 inch width shall be saw-cut to 1/4 inch minimum in width and depth. Saw cut a 1/4 inch by 1/4 inch kerf around drain flanges. Clean, prime and fill saw-cuts flush with an approved sealant by CCW or CCW-201 polyurethane sealant.
 4. All moving cracks over 1/16 inch wide and all expansion joints less than 1 inch wide shall be cleaned, primed, fitted with a backing rod and caulked with CCW-201 polyurethane sealant. For larger joints, contact manufacturer's representative.
 5. Allow all sealant to cure thoroughly before applying coating.
 6. Prime all areas to receive detail coats following priming instructions in Section 3.3 A. Extend primer 2 inches beyond area to receive detail coat to allow primer tie-in during coating application.
 7. Apply a 6 inch wide stripe-coat of CCW-501-T, coating 30 mils thick centered over all sealed cracks, hairline cracks, sealant cants, control and cold joints and expansion joints less than 1 inch wide.
- B. All required metal and neoprene flashings shall be installed at this time. Apply a stripe coat of CCW-501-T Detail Coat, 30 mils thick, 6 inches wide, centered over all transitions from concrete to metal flashings and reinforce with CCW Reinforcing Fabric. Allow the stripe coat to cure overnight (16 hours minimum).

3.3 APPLICATION

A. Priming:

1. Stir each side separately to ensure that no separation has occurred, then mix all of Part A with all of Part B. Use a mixing paddle in a slow-speed drill motor. Mix 2 to 3 minutes until a homogenous blend is achieved. Allow 15 to 30 minute induction period before applying.
2. Apply primer at a rate of 400 square feet per gallon. Avoid puddles or ponding the primer and do not apply primer over stripe coats.
3. Allow primer to dry for 1 hour minimum, 8 hours maximum. Primer is sufficiently dry when it is somewhat tacky but will not transfer

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when touched. In the event coating is not applied within the maximum time, reprime.

- B. CCW-501 Base Membrane: Apply in one uniform coat at the rate of one gallon minimum per 60 square feet or as needed in order to obtain a minimum thickness of 26 wet mils. Allow the base membrane to cure 16 to 48 hours.

- C. CCW-502 Elastomeric Membrane:
1. Standard Traffic Areas: Apply CCW-502 in one uniform coat at the rate of one gallon minimum per 100 square feet or as needed in order to obtain a minimum thickness of 16 wet mils. Immediately broadcast 16 mesh aggregate into the wet material at a rate of 10 to 12 lbs. per 100 square feet and backroll. Allow the membrane to cure 16 to 48 hours.
 2. Heavy Traffic Areas: After installation of CCW-502 as above, apply an additional coat of CCW-502 at the rate of one gallon minimum per 100 square feet. Uniformly broadcast 20-mesh sand over the surface at 15 to 25 lbs per 100 square feet. Allow to cure 16 hours.
- D. CCW-503 Top Coat: Apply in one uniform coat at the rate of one gallon minimum per 100 square feet or as needed in order to obtain a minimum thickness of 16 wet mils. Backroll for uniformity.
- E. Traffic on coated surface: The completed coating system shall not be subject to any traffic during the first 24 hours after application is complete, nor to any vehicular traffic during the first 48 hours after application of the final coat. Cool temperatures will significantly increase the required cure time. If the work of the applicator has not been approved by the prime contractor during the first 48 hours after application is complete, then there shall be no traffic of any type allowed until such acceptance and approval is given.
- F. Note: All fluid applied product application rates are based on theoretical coverage relative to the percentage of solids in the material. These are minimum application rates to achieve the required dry film thickness for the system and do not account for substrate condition or porosity. A thicker application of the product may be necessary to achieve the required dry film thickness for system relative to the substrate.

END OF SECTION

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**SECTION 072100 – THERMAL
INSULATION**

PART 1 - GENERAL

1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
1. Perimeter wall insulation (supporting backfill).
 2. Concealed building insulation.
 3. Vapor retarders.
- B. Related Sections include the following:
1. Division 04 Section 042200 "Concrete Unit Masonry" for insulation installed in cavity walls and masonry cells.
 2. Division 07 Section 071300 "Sheet Membrane Waterproofing" for insulation and insulated drainage panels installed with waterproofing.
 3. Division 07 Section 075323 "EPDM Roofing" for insulation specified as part of roofing construction.

1.3 DEFINITIONS

- A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 PERFORMANCE REQUIREMENTS

- A. R-Values: Unless otherwise indicated, provide the following minimum R-values:
1. Roof decks: R-23.0 continuous insulation.
 2. Walls above grade: R-13.0+3.8 continuous insulation.
 3. Walls below grade: R-10.0 continuous insulation.
 4. Perimeter Slab-on-Grade: R-10.0.
- B. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.
1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for four (4) hours at 2500-fpm (13-m/s) air velocity.

2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with *Chaetomium globosum* on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, 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.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturers written instructions for handling, storing and protecting during installation.
- B. Protect plastic insulation as follows:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 3. Complete insulation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a) DiversiFoam Products.
 - b) Dow Chemical Company (The).
 - c) Owens Corning.
 - d) Pactiv Building Products.
 - 2. Type IV, 25 psi (173 kPa).

2.3 VAPOR RETARDERS

- A. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: Two (2) outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 22 lb. / 1000 sq. ft. (10kg/100 sq. m), with maximum permeance rating of 0.1317 per (7.56 ng/Pa x s x sq. m) and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively.
 - 1. Products:
 - a. Raven Industries Inc.; DURA-SKRIM 2FR.
 - b. Reef Industries, Inc.; Griffolyn T-55 FR.
- B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.4 AUXILIARY INSULATING MATERIALS

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturer for sealing joints and penetrations in vapor-retarder facings.
- B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
 - 1. Products”
 - a. AGM Industries, Inc.; Series R RACTOO Insul-Hangers.
 - b. Eckel Industries of Canada; Stic-Klip Type N Fasteners.
 - c. Gemco; Spindle Type.
 - 2. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch (.0762 mm) thick by 2 inches (50 mm) square.
 - 3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.
- B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates:
 - 1. Products:
 - a. AGM Industries, Inc.; TACTT Adhesive.
 - b. Eckel Industries of Canada; Stic-Klip Type S Adhesive.
 - c. Gemco; Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer’s written instruction applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For performed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to product thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical foundation wall surfaces, set insulation units using manufacturer recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of twenty-four (24) inches below exterior grade line.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended in insulation manufacturer.
- C. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements
 - 1. Remove below-grade construction, including basements, foundation walls, and footings, to depths indicated.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures.
 - 4. For wood-framed construction, install mineral-fiber blankets according to ASTM c 1320 and as follows:
 - a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.
 - b. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarded once finish material is installed over it.

3.6 INSTALLATION OF VAPOR RETARDERS

- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacture.

- C. Seal joints caused by pipes, conduit, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.7 PROTECTION

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

END OF SECTION 072100

SECTION 07 21 23

FOUNDATION, SLAB-ON-GRADE INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: This section covers the installation of insulation in a foundation/ slab-on-grade application.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM C 578-85 - Specification for Preformed, Cellular Polystyrene Thermal Insulation.
 - 2. ASTM D 1621-73 - Test for Compressive Properties of Rigid Cellular Plastics
 - 3. ASTM C 518-76 - Test for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter.
- B. Model Codes:
 - 1. ICBO No. 2257.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data in accordance with Section 01 33 00 - Submittals.
- B. Assurance Quality Control:
 - 1. Manufacturer's Instructions: Submit manufacturer's installation instructions in accordance with Section 01300 - Submittals.

1.4 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify recycled material content for recycled content products.
 - b. Certify source for local and regional materials and distance from Project site.

- 2. Indoor Air Quality Certificates:
 - a. Certify volatile organic compound content for each interior adhesive and sealant and related primer.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
 - 1. Provide cost data for the following products:
 - a. Products with recycled material content.
 - b. Local and regional products.

1.5 QUALITY ASSURANCE

- A. The insulation shall be manufactured with a blowing agent that provides at least a 90% reduction in ozone depletion potential compared to standard CFC blowing agents. Other insulation's are not acceptable.
- B. Sustainable Design Requirements:
 - 1. Recycled Content Materials: Furnish materials with recycled content whenever possible, including pre-consumer and post-consumer materials.
 - 2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading: Deliver, store and handle material in accordance with Section 01 60 00 – Product Requirements.
- B. Storage and Protection: The insulation shall be shielded from sunlight when stored outdoors for extended periods. Cover with an opaque light-colored tarp for protection from solar radiation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufactures - Insulation:
 - 1. Dow Chemical Company
 - 2. Owens Corning
 - 3. Amoco Foam Products Company.
- B. Acceptable manufactures - Adhesive:
 - 1. Contech PL300 Foam Board Adhesive or other compatible polystyrene foam board adhesive.
- C. Substitutions: Under the provisions of Section 01 60 00.

2.2 MATERIALS

- A. Insulation:
 - 1. Insulation shall be Styrofoam Brand Score Board Insulation manufactured by the Dow Chemical Company.
 - 2. The product shall meet ASTM C 578-85, Type IV.
 - 3. The insulation shall be 48 inches wide by 96 inches long by 2 inches in thickness to achieve the desired U-factor through the completed wall construction.
 - 4. Insulation shall have and aged R-value of 5.0 ft²•h•°F/Btu per inch of thickness when tested at 75°F mean temperature in accordance with ASTM C 518-76.
- B. Associated Materials:
 - 1. Adhesive: Contech PL300 Foam Board Adhesive or other compatible polystyrene foam board adhesive.
 - 2. Insulation Fasteners: Insulation fasteners shall be galvanized mechanical fasteners with large heads or including large washers.

PART 3 EXECUTION

3.1 PREPARATION

- A. Foundation wall substrate, adjacent materials and insulation boards shall be dry and ready to receive insulation and adhesive.
- B. Foundation wall substrate shall be flat and free of fins and irregularities and other materials that may impede adhesive bond.
- C. Floor slab grade shall be well tamped, and drained.

3.2 BOARD INSTALLATION ON FOUNDATION WALL

- A. Exterior: Place insulation boards with long edge horizontally or vertically on the exterior foundation wall from finished grade down 4 feet below grade.
- B. Interior: Place insulation boards with long edge horizontally or vertically on the interior foundation wall from a point establishing the top of the proposed floor slab down 4 feet.
- C. Secure boards to the foundation wall with adhesive.
- D. Butt all edges tightly. Stagger all end joints.

3.3 BOARD INSTALLATION UNDERNEATH FLOOR SLAB

- A. Place insulation boards horizontally on grade around the perimeter butted up to the foundation wall and extending inward 2 feet to the center of the floor space.

END OF SECTION

SECTION 07 21 39

SPRAYED INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sprayed insulation.

1.2 REFERENCES

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E136 – (Noncombustibility) Behavior of Materials in a Vertical Tub Furnace at 750° C.
- C. ASTM C423 – Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- D. ASTM C518 – Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- E. ASMTM C1014 – Spray Applied Mineral Fiber Thermal or Acoustical Insulation.

1.3 SUBMITTALS FOR REVIEW

- A. Section 01 30 00 - Submittals: Procedures for submittals.
- B. Product Data: Submit manufacturer's specifications, including certification as may be required to show material compliance with Contract Documents.

1.4 SUBMITTALS FOR INFORMATION

- A. Section 01 30 00 - Submittals: Procedures for submittals.
- B. Test Reports: Reports from reputable independent testing agencies for proposed products.
- C. Manufacturer's Installation Instructions: Indicate special procedures, and conditions requiring special attention.
- D. Manufacturer's Certificate:
 - 1. Certify that sprayed insulation products meet or exceed requirements of contract documents.

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2. Certify that sprayed insulation products contain no asbestos or other finely-divided particulate matter that can be released as an airborne health hazard during or after application.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section, with minimum three years of documented experience and approved by manufacturer.

1.6 MOCK-UP

- A. Section 01 40 00 - Quality Control: Requirements for mock-up.
- B. Construct mock-up, 4 feet long by 4 feet wide. Conform to project requirements for thickness, and density of application.
- C. Locate where directed.
- D. Examine installation within one hour of application to determine variances from specified requirements due to shrinkage, temperature, and humidity.
- E. Where shrinkage and cracking are evident, adjust mixture and method of application as necessary. Remove materials and re-construct mock-up.
- F. Mock-up may remain as part of the Work.

1.7 PRE-INSTALLATION MEETING

- A. Section 01 30 00 – Administrative Procedures: Pre-installation meeting.
- B. Convene one week prior to commencing work of this section.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Material and Equipment: Environmental conditions affecting products on site.
- B. Do not apply spray insulation materials when temperature of substrate material and surrounding air is below 40 degrees F .
- C. Provide ventilation in areas to receive insulation during application and 24 hours afterward, to dry applied material.
- D. Provide temporary enclosure to prevent spray from contaminating air.

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1.9 PROJECT CONDITIONS

- A. Section 01 30 00 – Administrative Procedures.
- B. Sequence work in conjunction with placement of ceiling hanger tabs, mechanical component hangers, and electrical components.

1.10 WARRANTY

- A. Section 01 70 00 - Contract Closeout.
- B. Correct defective Work within a five year period after Date of Substantial Completion. Include coverage for insulation to remain free from cracking, checking, dusting, flaking, spalling, separation, and blistering. Reinstall or repair failures that occur within warranty period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Isolatek International, 41 Furnace Street, Stanhope, NJ 07874.
- B. Substitutions: Refer to Section 01 60 00 – Product Requirements.

2.2 MATERIALS

- A. Materials shall be CAFCO® HEAT-SHIELD® as manufactured by Isolatek applied to conform to the Drawings, Specifications and the following test criteria:
 - 1. Surface Burning Characteristics: When tested in accordance with ASTM E84, the material shall exhibit the following surface burning characteristics:
 - a. Flame Spread: 0
 - b. Smoke Developed: 0
 - 2. Noncombustibility: When tested in accordance with ASTM E136, the material shall be noncombustible.
 - 3. Noise Reduction Coefficients: When tested in accordance with ASTM C423, the material shall have the following NRC ratings:

| <u>Thickness</u> | <u>Substrate</u> | <u>NRC</u> |
|------------------|------------------|------------|
| ½ inch | Solid Base | 0.50 |
| 1 inch | Solid Base | 0.75 |
| 2 inch | Solid Base | 1.05 |

- 4. When tested in accordance with ASTM C518, the material shall have an “R” value of 3.85 per inch.
- 5. Potable water shall be used for the application of sprayed insulation materials.

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PART 3 EXECUTION**

**SECTION 07 21 39 – SPRAYED
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3.1 EXAMINATION

- A. Section 01 30 00 – Administrative Procedures: Verification of existing conditions before starting work.
- B. Verify that surfaces are ready to receive insulation.
- C. Verify that clips, hangers, supports, sleeves, and other items required to penetrate insulation are in place.
- D. Verify that ducts, piping, equipment, or other items that would interfere with application of insulation have not been installed.
- E. Verify that voids and cracks in substrate have been filled. Verify that projections have been removed where insulation will be exposed to view as a finish material.

3.2 PREPARATION

- A. All surfaces to receive insulation shall be free of oil, grease, loose mill scale, dirt, paints/primers (other than those listed and tested) or other foreign materials that would impair satisfactory bonding to the surface.
- B. Clips, hangers, supports, sleeves and other attachments to the substrate are to be placed by others prior to the application of spray-applied insulation materials.
- C. The installation of ducts, piping, conduit or other suspended equipment shall not take place until the application of sprayed insulation is complete.
- D. The spray-applied insulation material shall only be applied to steel deck that has been constructed in accordance with the criteria set forth by the Steel Deck Institute.

3.3 APPLICATION

- A. Equipment, mixing and application shall be in accordance with the manufacturer's written application instructions.
- B. The application of spray-applied insulation material shall not commence until certification has been received that surfaces to receive sprayed insulation have been inspected by the applicator and are acceptable to receive sprayed insulation.
- C. All unsuitable substrates must be identified corrected prior to the application of the spray-applied insulation material.

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- D. The application of sprayed insulation to the underside of roof deck shall not commence until the roof is completely installed and tight.
- E. Proper temperature and ventilation shall be maintained as specified in Part 1.
- F. Provide masking, drop cloths or other suitable coverings to prevent overspray from coming in contact with surfaces not intended to be sprayed.
- G. Adhesive shall be applied as per manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Control: Field inspection and testing.
- B. Independent Testing Agency will:
 - 1. Inspect the installed insulation after application and curing for integrity, prior to its concealment.
 - 2. Ensure that actual thickness', densities, and bond strengths meet requirements specified.
 - 3. Re-inspect the installed insulation for integrity of fire protection, after installation of subsequent Work.

3.5 CLEANING

- A. Section 01 70 00 - Contract Closeout: Cleaning installed work.
- B. Remove excess material, overspray, droppings, and debris.
- C. Remove insulation from materials and surfaces not required to be fireproofed.
- D. At exposed insulation, clean surfaces that have become soiled or stained, using manufacturer's recommended procedures.

END OF SECTION

SECTION 07 26 16

UNDER-SLAB VAPOR BARRIER

PART 1 GENERAL

1.1 SUMMARY

- A. Products Supplied Under This Section
 - 1. Vapor barrier, seam tape, mastic, and pipe boots for installation under concrete slabs.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM E 1745-97 (2004) Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
 - 2. ASTM E 154-99 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
 - 3. ASTM E 96-05 Standard Test Methods for Water Vapor Transmission of Materials
 - 4. ASTM F 1249-06 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
 - 5. ASTM E 1643-98 (2005) Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
- B. American Concrete Institute (ACI)
 - 1. ACI 302.1R-04 Vapor barrier component (plastic membrane) is not less than 10 mils thick.

1.3 SUBMITTALS

- A. Quality Control / Assurance
 - 1. Manufacturer's samples, literature
 - 2. Manufacturer's installation instructions for placement, seaming and pipe boot installation

PART 2 PRODUCTS

2.1 MATERIALS

- A. Vapor Barrier must have all of the following qualities:
 - 1. Permeance of less than 0.01 Perms [grains/(ft² *hr * in.Hg)] per ASTM F 1249 or ASTM E 96
 - 2. Maintain permeance of less than 0.01 Perms [grains/(ft² *hr * in.Hg)] after mandatory conditioning tests per ASTM E 154 Sections 8,11,12, and 13.
 - 3. ASTM E 1745 Class A
- B. Vapor Barrier products:
 - 1. Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.

2.2 ACCESSORIES

- A. Seam Tape:
 - 1. Permeance less than 0.3 perms per ASTM F 1249 or ASTM E 96
 - 2. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com
- B. Vapor Proofing Mastic:
 - 1. Permeance less than 0.3 perms per ASTM F 1249 or ASTM E 96
 - 2. Stego Mastic by Stego Industries LLC, (877) 46407834 www.stegoindustries.com
- C. Pipe Boots
 - 1. Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ensure that subsoil is approved by Architect or Geotechnical Engineer.
 - 1. Level and tamp or roll aggregate, sand or granular base.

3.2 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E 1643-98 (2005).
 - 1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete pour.
 - 2. Lap vapor barrier over footings and/or seal to foundation walls.
 - 3. Overlap joints 6 inches and seal with manufacturer's tape.
 - 4. Seal all penetrations (including pipes) per manufacturer's instructions.
 - 5. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
 - 6. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

END OF SECTION

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**SECTION 074213.23 – COMPOSITE METAL
WALL PANELS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Metal-faced composite wall panels.
 - 2. Metal-faced composite soffit panels
- B. Related Sections:
 - 1. Division 5 Section 054000 "Cold-Formed Metal Framing" for cold-formed metal framing supporting metal-faced composite wall panels.
 - 2. Division 7 Section 076200 "Sheet Metal Flashing and Trim" for field-formed flashings and other sheet metal work not part of metal-faced composite wall panel assemblies.

1.3 DEFINITION

- A. Metal-Faced Composite Wall Panel Assembly: Metal-faced composite wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight wall system.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal-faced composite wall and soffit panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction. At a minimum the system must perform per all code requirements.
- B. Delegated Design: Design metal wall and soffit panel assemblies using performance requirements and design criteria indicated.
- C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..
- E. Water Penetration under Dynamic Pressure: No evidence of water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft.
1. Water Leakage: As defined according to AAMA 501.1.
- F. Structural Performance: Provide metal-faced composite wall and soffit panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure of 20 lbf/sq. ft., acting inward or outward.
 - b. Uniform pressure as indicated on Drawings.
 2. Deflection Limits: Metal-faced composite wall and soffit panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/240 of the span at the perimeter and 1/100 of the span anywhere in the panel.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations 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 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 each type of metal-faced composite or soffit panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal-faced composite and soffit panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among factory-, shop-, and field-assembled work.
1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Anchorage systems.

- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Metal-Faced Composite Wall Panels: Minimum 12 x 12 inches. Include fasteners, closures, and other metal-faced composite wall panel accessories.
 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 3. Accessories: 12-inch-long Samples for each type of accessory.
 4. Exposed Gaskets: 12 inches long.
 5. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of metal-faced composite wall panels adjacent to joint sealants.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Exterior elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Wall panels and attachments.
 2. Girts, Stud framing.
- B. 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.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal wall panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of metal-faced composite wall or soffit panel from single source from single manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal-faced composite wall and soffit panels, and other manufactured items so as not to be damaged or deformed. Package metal-faced composite panels for protection during transportation and handling.

- B. Unload, store, and erect metal-faced composite panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Store metal-faced composite panels vertically, covered with suitable weathertight and ventilated covering. Store metal-faced composite panels to ensure dryness, with positive slope for drainage of water. Do not store metal-faced composite panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F.
- D. Retain strippable protective covering on metal-faced composite panel for period of panel installation.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal-faced composite panels to be performed according to manufacturer's written instructions and warranty requirements.

1.11 COORDINATION

- A. Coordinate metal-faced composite panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show 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: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

- A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - 1. Surface: Smooth, flat finish.
 - 2. Exposed Coil-Coated Finishes:
 - a. Mica Fluoropolymer: AAMA 620. 2-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. Panel Sealants:
 - 1. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal-faced composite wall panels and remain weathertight; and as recommended in writing by panel manufacturer.

2.2 MISCELLANEOUS METAL FRAMING

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Subgirts: Manufacturer's standard C- or Z-shaped sections 0.064-inch nominal thickness.
- C. Zee Clips: 0.079-inch nominal thickness.
- D. Base or Sill Channels: 0.079-inch nominal thickness.
- E. Hat-Shaped, Rigid Furring Channels:
 - 1. Nominal Thickness: 0.040 inch.
- F. Cold-Rolled Furring Channels: Minimum 1/2-inch-wide flange.
 - 1. Nominal Thickness 0.064 inch.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with nominal thickness of 0.040 inch.
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

- G. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, and depth required to fit insulation thickness indicated.
 - 1. Nominal Thickness: 0.025 inch.
- H. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

2.4 METAL-FACED COMPOSITE PANELS

- A. General: Provide factory-formed and -assembled, metal-faced composite wall and soffit panels fabricated from two metal facings bonded, using no glues or adhesives, to solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components using concealed fasteners and accessories required for weathertight system.
 - 1. Fire-Retardant Core: Noncombustible, with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alcan Composites USA Inc.; Alucobond, Alucobond Plus.
 - b. Alcoa Inc.; Reynobond.
 - c. ALPOLIC, Division of Mitsubishi Chemical America, Inc.; ALPOLIC.
 - d. CENTRIA Architectural Systems; Formabond Wall System.
 - e. Citadel Architectural Products, Inc., Envelope 2000.
 - f. Protean Construction Products, Inc.; ACM 100.
- B. Aluminum-Faced Composite Wall Panels Formed with 0.020-inch-thick, coil-coated aluminum sheet facings.
 - 1. Panel Thickness: min. 0.157 inch.
 - 2. Core: Fire retardant.
 - 3. Exterior Finish: 3-coat fluoropolymer.
 - a. Color: To match PPG Duranar FC XL Ultra Cool Gold Champagne 8783 with 5MC88680 Clear

- C. Attachment System Components: Formed from material compatible with panel facing.

2.5 ACCESSORIES

- A. Wall Panel Accessories: Provide components required for a complete metal-faced composite wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal-faced composite wall panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where necessary to ensure weathertight construction.
- B. Flashing and Trim: Formed from 0.018-inch-minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal-faced composite wall panels.

2.6 FABRICATION

- A. General: Fabricate and finish metal-faced composite panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal-faced composite panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- C. Metal-Faced Composite Panels: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.
 - 1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
 - 2. Fabricate panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
 - 3. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape.
 - 4. Dimensional Tolerances:

- a. Panel Bow: 0.8 percent maximum of panel length or width.
 - b. Squareness: 0.25 inch maximum.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal-faced composite wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal-faced composite wall panel manufacturer for application, but not less than thickness of metal being secured.

2.7 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 and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 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 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal-faced composite wall panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal-faced composite wall panel manufacturer.
 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal-faced composite wall panel manufacturer.
- B. Examine roughing-in for components and systems penetrating metal-faced composite wall panels to verify actual locations of penetrations relative to seam locations of panels before panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal-faced composite wall panel manufacturer's written instructions.
1. Soffit Framing: Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 METAL-FACED COMPOSITE WALL PANEL INSTALLATION

- A. General: Install metal-faced composite panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Commence metal-faced composite soffit panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
 2. Shim or otherwise plumb substrates receiving metal-faced composite wall panels.
 3. Flash and seal metal-faced composite panels at perimeter of all openings. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
 4. Install flashing and trim as metal-faced composite panel work proceeds.
 5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
 6. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners:
1. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal-faced composite wall panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal-faced composite panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.
 - 1. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."
- E. Attachment System Installation, General: Install attachment system required to support metal-faced composite panels and to provide a complete weathertight system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
 - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
 - 2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.
- F. Clip Installation: Attach panel clips to supports at each metal-faced composite wall panel joint at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-turned flanges of wall panels to panel clips with manufacturer's standard fasteners.
 - 1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Division 7 Section "Joint Sealants."

3.4 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal-faced composite panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal-faced composite wall panel units within installed tolerance of 1/4 inch in 20 feet, nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

- A. Water-Spray Test: After completing the installation of 300 sq. ft. minimum area of metal-faced composite soffit panel assembly, test assembly for water penetration according to AAMA 501..
- B. Metal-faced composite panels will be considered defective if they do not pass tests and inspections.
- C. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.7 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal-faced composite panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal-faced composite panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.
- B. After metal-faced composite panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal-faced composite panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.23

**NEW PARKING STRUCTURE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 075323 – ETHYLENE-PROPYLENE-
DIENE-MONOMER (EPDM) ROOFING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Adhered EPDM membrane roofing system.
 - 2. Vapor retarder.
 - 3. Roof insulation.
- B. Related Sections:
 - 1. Division 06 Section 061000 "Rough Carpentry" for wood nailers, curbs and blocking.
 - 2. Division 07 Section 076200 "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings and counterflashings.
 - 3. Division 07 Section "Roof Specialties" for proprietary manufactured roof specialties.
 - 4. Division 07 Section 079200 "Joint Sealers" for joint sealants, joint fillers and joint preparation.
 - 5. Division 15 Section "Sanitary, Vent and Storm Drainage Piping" for roof drains.

1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions and terms related to roofing work in this Section.

1.4 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, fabrications, 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 bases 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.
- D. Thermal Performance: Provide roofing system with U-value less than or equal to 0.043; R-23.0 continuous insulation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
 - 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products:
 - 1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
 - 2. Roof insulation.
 - 3. Metal termination bars.
 - 4. Battens.
 - 5. Six insulation fasteners of each type, length, and finish.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of compliance with performance requirements.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.
- D. Field quality-control reports.
- E. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. **Manufacturer Qualification:** A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.
- B. **Installer Qualifications:** A qualified firm that is approved, authorized or licensed by membrane roofing system manufacturer to install manufacturer's products and that is eligible to receive manufacturer's special warranty. Minimum five (5) years in business.
- C. **Source Limitations:** Obtain all components including, but not limited to, roof insulation and fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. **Exterior Fire-Test Exposure:** ASTM 3 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. **Fire-Resistance Ratings:** Where indicated, provide fire-resistance-rated roof assemblies 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.
- F. **Preinstallation Roofing Conference:** Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing installer, roofing system manufacturer's representative, deck installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashing, special roofing details, roof drainage, roof penetrations, equipment curbs and condition of other construction that will affect roofing system.
 - 7. Review governing regulations and requirements for insurance and certifications, if applicable.
 - 8. Review temporary protection requirements for roofing system during and after installation.
 - 9. Review roof observation and repair procedures after roofing installation.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

- B. Store liquid materials in their original undamaged containers in a clean, dry, protected locations within the temperature range required by roofing system manufacturer. Protection stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling and others sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard or customized form, with monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
- B. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, substrate boards, roofing accessories, and other components of membrane roofing system.
- C. Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EPDM MEMBRANE ROOFING

- A. EPDM: ASTM D 4637, Type I, non-reinforced, uniform, flexible EPDM sheet.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products Company.
 - c. GenFlex Roofing Systems.
 - d. Johns Manville.
 - e. Versico Incorporated.
 - 2. Thickness: 90 mils, nominal.
 - 3. Exposed Face Color: Black.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. General: Auxiliary membrane roofing materials (including Cover Board) as recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Single-Ply Roof Membrane Adhesives: 250 g/L.
 - f. Other Adhesives: 250 g/L.
 - g. Single-Ply Roof Membrane Sealants: 450 g/L.
 - h. Nonmembrane Roof Sealants: 300 g/L.
 - i. Sealant Primers for Nonporous Substrates: 250 g/L.
 - j. Sealant Primers for Porous Substrates: 775 g/L.
- B. Sheet Flashing: 60-mil-thick EPDM, partially cured or cured, according to application.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch-wide minimum, butyl splice tape with release film.
- E. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.
- F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- G. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provision in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.3 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch thick.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Georgia-Pacific Corporation; DensDeck.

- b. Temple-Inland Inc.; GreenGlass
 - c. United States Gypsum Co.; Securock.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.4 VAPOR RETARDER

- A. Reinforced-Polyethylene Vapor Retarders: Two outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 25 lb / 1000 sq. ft. (12 kg/100 sq. m), with maximum permeance rating of 0.0507 perm (2.9 ng/Pa x s x sq. m).
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Raven Industries, Inc.; DURA-SKRIM 6WW.
 - b. Reef Industries, Inc.; Griffolyn T-6.
 - 2. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
 - 3. Adhesive: Manufacturer's standard lap adhesive.

2.5 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by EPDM membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that product FM Approvals-approved roof insulation.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
- D. Provide pre-formed saddles, crickets, tapered edge strips and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

2.7 PIPE BOOTS

- A. Provide pipe boots for single and multiple pipe penetrations. Size and configuration to be appropriate for each specific penetration location. Material to be compatible with roofing systems and to include stainless steel compression ring for each pipe.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Commercial Products Group; PortalsPlus C-412.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies 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 plan flatness and fastening of steel roof deck complies with requirements of Division 95 Section "Steel Decking."
 - 4. Verify that minimum concrete drying period recommended by roofing system manufacturer is passed.
 - 5. Verify that concrete substrate is visible dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projection.
- B. Prevent materials from entering or clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

3.4 VAPOR-RETARDER INSTALLATION

- A. Laminate Sheet: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum 2 inches and 6 inches respectively.
 - 1. Apply adhesive at rate recommended by vapor-retarder manufacturer. Continuously seal side and end laps with adhesive.
- B. Completely seal vapor retarder at terminations, obstruction, and penetrations to prevent air movement into membrane roofing system.

3.5 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints to previous layer a minimum of 6 inches (150 mm) in each direction.
- E. Where installing composite and non-composite insulation in two or more layers, install non-composite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
- F. Trim surface of insulation where necessary at roof drains so complete surface is flush and does not restrict flow of water.
- G. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding ¼ inch (6 mm) with insulation.
- H. Cut and fit insulation within ¼ inch (6 mm) of nailers, projections and penetrations.
- I. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
- B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacture. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations and perimeter of roofing.
- F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- G. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.
- H. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
 - 1. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.7 BASE FLASHING INSTALLATION

- A. Install sheet flashing and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured and uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashing and mechanically anchor to substrate through termination bars.

3.8 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- B. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or addition work with specified requirements.

3.9 PROTECTION AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to the Architect and the Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacture or affected construction.

END OF SECTION 075323

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Roof flashings.
- B. Expansion and Control Joint Flashings and Counterflashings.
- C. Fascia.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in sheet metal flashing work with three years minimum experience.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Describe material profile, jointing pattern, jointing details, fastening methods, and installation details.
- C. Submit manufacturer's installation instructions under provisions of Section 01 30 00.
- D. Submit samples under provisions of Section 01 33 00.

1.4 STORAGE AND HANDLING

- A. Store products under provisions of Section 01 60 00.
- B. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation.
- C. Prevent contact with materials during storage that may cause discoloration, staining, or damage.

1.5 PRE-INSTALLATION CONFERENCE

- A. Convene one week, minimum, prior to commencing work of this section, under provisions of Section 01 30 00.

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1.6 WARRANTY

- A. Provide twenty year warranty under provisions of Section 01 70 00.
- B. Warranty: Include coverage for degradation of metal finish.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

- A. Sheet Flashings and Trim: Pac-Clad, prefinished 24 gauge galvanized sheet metal; Kynar 500 finish; as manufactured by "Peterson Aluminum Corporation". All flashings and trim material shall be supplied by one manufacturer.
- B. Other acceptable manufacturers offering equivalent products:
 - 1. ColorKlad by Vincent Metals
 - 2. Una-Clad by Copper Sales, Inc.
 - 3. Duracal by N.B. Handy Company
- C. Substitutions: Under the provisions of Section 01 60 00.

2.2 COMPONENTS

- A. Roof flashings and miscellaneous flashing and trim: Prefinished sheet metal; Color as selected by Architect from manufacturers full range of standard colors.

2.3 FASTENERS

- A. Fasteners such as nails, screws, bolts, etc. shall be of same materials as flashings on which they are used unless noted otherwise. They shall be of type and size as shown on Drawings or specified herein. All fasteners exposed to the weather shall be solid stainless steel with neoprene washers under heads to ensure corrosion resistance and watertightness.
- B. Sheet Metal to Wood: No. 8 minimum size and of sufficient length to penetrate 1-1/4 inches into wood. Installed withdrawal resistance shall be a minimum of 150 lbs per screw.
- C. Sheet Metal to Sheet Metal: Self-tapping sheet metal screws of 1/2 inch length and a minimum #3 diameter.
- D. Keeper Strips to Wood: Annular thread nail with minimum 3/16 inch diameter head and of sufficient length to penetrate wood 1-1/4 inch minimum.
- E. Screws for aluminum shall be stainless steel only.

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- F. Sheet Metal to Concrete or Masonry: Specially threaded anchors, brand name "Tapcon", 3/16 inch minimum diameter, length to penetrate masonry minimum 1-1/2 inches. The installed withdrawal resistance to be minimum of 300 lbs per anchor.
- G. Lag Screws: 3/8 inch with 1-1/2 inches penetrating into sleeper blocking.

2.4 ACCESSORIES

- A. Sealant: Type specified in Section 07 92 00.
- B. Sealant Tape: Pressure-Sensitive SecurTAPE as manufactured by Carlisle Syntec, Inc.
- C. Expansion Joint Material: Sure-Seal Expansion Joints as manufactured by Carlisle Syntec, Inc.

2.5 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats and starter strips of same material as sheet, continuous width, interlockable with sheet.
- C. Form pieces in longest practical lengths.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- E. Form material with cover plate seam.
- F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- H. Form sheet metal to profiles indicated on the drawings.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.
- B. Verify membrane termination and base flashings are in place, sealed, and secure.

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- C. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Field measure site conditions prior to fabricating work.
- B. Install starter and edge strips, and cleats before starting installation.
- C. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- D. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations approved by Architect.
- E. Seam and seal all joints.
- F. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- G. Seal metal joints watertight.

3.3 INSTALLATION

- A. Install sheet metal flashing and trim as indicated on Drawings. In addition, methods, details and standards shall comply with National Roofing Contractors Association - Roofing Manual all as approved by the Architect.

END OF SECTION

**SECTION 07 65 00
FLEXIBLE FLASHINGS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes copper laminated flashings for masonry construction.

1.2 SUBMITTALS

- A. Product Data: Submit along with each product; the properties, samples, and complete installation details and procedures in accordance with Section 01 33 00 - Submittals.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Flashing and surface conditioner shall be delivered in the original, unopened manufacturer's containers with all labeling information fully visible.
- B. On-site storage of unopened cartons shall be such that the material is kept dry and is not stored at temperatures in excess of 100°F. Pallets of cartons shall not be double stacked for on-site storage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. York Manufacturing, Inc. PO Box 1009 Sanford, Maine 04073.
- B. Other acceptable manufacturers offering equivalent products:
 - 1. Polyte Manufacturing Corporation, 324 Ridge Avenue, Cambridge, MA 02140.
 - 2. Sandell Flashings Manufacturing Co. Inc., 399 West Main Street, Amsterdam, NY 12010.
 - 3. AFCO Products Inc., 44 Park Street, Somerville, Massachusetts 02143.
- C. Substitutions: Under the provisions of Section 01 60 00.

2.2 MATERIALS

- A. Concealed Flashing: York Flash-Vent™ as manufactured by York Manufacturing, Inc.

- B. Mastic: Cop-R-Tite Mastic as manufactured by York Manufacturing, Inc.

PART 3 EXECUTION

3.1 INSTALLATION - MASONRY

- A. General:
1. Horizontal Masonry Surfaces: The flashing for horizontal masonry surfaces shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turning up where possible to facilitate drainage through the weepholes, then turned up on back wall not less than 8" or carried upward across the cavity a minimum of 8". Flashing shall then be secured in back wall mortar joint or reglet.
 2. Vertical Masonry Surfaces: Surfaces receiving the flashing shall be fully coated with fibrated asphalt mastic to hold it in place. Secure in back wall mortar joint or reglet.
- B. Thru-Wall Flashing: Flashing shall be laid in a full bed of mastic and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turning up where possible to facilitate drainage through weepholes. Turn flashing up on the back wall not less than 8" or carry upward across the cavity a minimum of 8" and secure in the back wall mortar or reglet.
- C. Heads and Sill Flashing: Flashing shall be laid in a full bed of mastic and topped with a fresh full bed of mortar. Flashing for heads and sills shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and turned up at the inside not less than 8". Head flashing shall be carried 6" beyond both ends of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, not cut. Install weep holes.
- D. Joining of Materials: All flashing material shall be lapped a minimum of four inches and the contacting surfaces coated with mastic.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Elastomeric intumescent firestopping materials at wall and floor openings and at periphery of fire-rated construction.

1.2 REFERENCES

- A. ASTM E-814: Fire Test of Through-Penetration Firestops.
- B. UL 1479: Fire Tests of Through-Penetration Firestops.
- C. UL Fire Resistance Directory: Through-Penetration Firestops Systems (XHEZ), and Fill, Void or Cavity Materials (XHHW).
- D. International Building Code (IBC)
- E. NFPA 101 Life Safety Code.
- F. NFPA 70: National Electrical Code.

1.3 DEFINITIONS

- A. Firestopping: A material, or combination of materials, to retain the integrity of time-rated construction by maintaining an effective barrier against the spread of flame, smoke and gases. It shall be used in specific locations as follows:
 - 1. Duct, cable, conduit and piping penetrations through floor slab and through time-rated partitions or fire walls.
 - 2. Openings between floor slabs and curtain walls, including inside hollow curtain walls at the floor slab.
 - 3. Penetrations of vertical service shafts.
 - 4. Openings and penetrations in time-related partitions or fire walls containing fire doors.
 - 5. Locations where specifically shown on the Drawings or where specified in other Sections of the Project Manual. Refer to Sections in Divisions 15 and 16.

1.4 SUBMITTALS

- A. Submit shop drawings, product data, certificates and manufacturer's installation instructions under provisions of Section 01 33 00.

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- B. Submit manufacturer's product data for all materials and prefabricated devices, providing descriptions sufficient for identification at the job site. Include manufacturer's instructions for installation.
- C. Submit manufacturer's product data, letter of certification, or certified laboratory test report that the material or combination of materials meet the requirements specified in ASTM E 814 positive pressure testing and are so classified in UL's Fire Resistance Directory.
- D. Submit shop drawings showing proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details shall reflect actual job conditions.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Section 01 60 00.
- B. Deliver in original unopened containers or packages bearing manufacturers' names, brand designations and product descriptions.
- C. Store materials under cover and protected from damage under provisions of Section 01 60 00.
- D. Do not use damaged materials.

1.6 SEQUENCING/SCHEDULING

- A. Coordinate the work of this Section with work performed under other Sections of the Project Manual. Refer to Divisions 15 and 16.

1.7 WARRANTY

- A. Guarantee against defects of materials for a period of five years, beginning with date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. 3M Contractor Products, St. Paul, Minnesota 55144-1000.
- B. Other acceptable manufacturers offering equivalent products:
 - 1. Dow Chemical Corporation
 - 2. GE Silicones.
 - 3. International Protective Coatings.
 - 4. Rectorseal Metacaulk Fire Stopping Sealants
 - 5. Nuco-Pak Inc.

- C. Substitutions: Under the provisions of Section 01 60 00.

2.2 COMPONENTS

- A. 3M Brand Fire Barrier CP 25N/S No Sag Caulk.
- B. 3M Brand Fire Barrier CP 25S/L Self-Leveling Caulk.
- C. 3M Brand Fire Barrier CP 25WB Caulk.
- D. 3M Brand Fire Barrier FS-195 Wrap/Strip.
- E. 3M Brand Fire Barrier CS-195 Composite Sheet.
- F. 3M Brand Fire Barrier 7900 Series Penetration Sealing Systems.
- G. 3M Brand Fire Barrier MPS-2 Moldable Putty Stix.
- H. 3M Brand Fire Barrier MPP-4S Moldable Putty Pads.
- I. Firestopping material shall be asbestos-free and capable of maintaining an effective barrier against flame, smoke and gases in compliance with the requirements of ASTM E-814 and UL 1479.
- J. Materials shall meet and be acceptable for use by the International Building Code.
- K. Materials shall meet the requirements of NFPA 101--Life Safety Code and NFPA 70--National Electric Code.
- L. Materials shall be suitable for the firestopping of penetrations made by steel, glass, plastic and insulated pipe.
- M. On insulated pipe, the fire-rating classification must not require removal of the insulation.
- N. The rating of the firestops shall be 1, 2 and 3 hours, but in no case less than the rating of the time-rated floor or wall assembly.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean surfaces to receive firestopping materials. Remove dirt, grease, oil, loose materials, rust or other substances that may affect installation or the fire resistance.

3.2 INSTALLATION

- A. Install firestopping materials as indicated in accordance with manufacturer's instructions.
- B. Seal all holes or voids made by penetrations to ensure an effective fire stop.
- C. Install firestopping materials so that void openings 4 inches or larger will support the required floor load, unless the opening is protected from possible loading or traffic.

3.3 FIELD QUALITY CONTROL

- A. Examine firestopped areas to ensure proper installation prior to concealing or enclosing firestopped areas.
- B. Areas of work shall remain accessible until inspection and approval by the applicable code authorities.

END OF SECTION

SECTION 07 92 00

JOINT SEALERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sealants and caulking.
- B. Flexible epoxy joint fillers.
- C. Backer rods.

1.2 REFERENCES

- A. U. S. Environmental Protection Agency (EPA): www.epa.gov: 40 CFR 59, Subpart D: National Volatile Organic Compound Emission Standards for Architectural Coatings.
- B. ASTM C 321 - Standard Test Method for Bond Strength of Chemical-Resistant Mortars.
- C. ASTM C 834 - Standard Specification for Latex Sealants.
- D. ASTM C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
- E. ASTM C 919 - Standard Practice for Use of Sealants in Acoustical Applications.
- F. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants.
- G. ASTM C 1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
- H. FS (Federal Specification) TT-S-00227E (COM-NBS) - Interim Federal Specification for Sealing Compound: Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures.
- I. FS (Federal Specification) TT-S-00230C - Interim Federal Specification for Sealing Compound: Elastomeric Type, Single Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures.
- J. FS (Federal Specification) TT-S-001543 (COM-NBS) - Interim Federal Specification for Sealing Compound: Silicone Rubber Base (for Caulking, Sealing, and Glazing in Buildings and Other Structures.

- K. US Green Building Council (USGBC): www.usgbc.org Leadership in Energy and Environmental Design (LEED) Green Building Rating System.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Comply with Bidding Requirements.
- C. Manufacturer's Technical Data Guides and application procedures.
- D. Submit samples illustrating colors selected.
- E. Submit laboratory tests or data validating product compliance with performance criteria specified.
- F. LEED Submittals:
 - 1. LEED NC Credit IEQ 4.1: Product data for sealant and sealant primers applied inside the weather envelope. Including statement of VOC content.
 - 2. LEED for Schools Credit EQ 4: Laboratory test reports for sealants and sealant primers applied inside the weather envelope, documents indicating compliance with California Department of Health Services testing and product requirements "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company regularly engaged in manufacturing and marketing of products specified in this section.
- B. Installer Qualifications: Qualified to perform work specified by reason of experience or training provided by product manufacturer.
- C. Mock-Ups: Include a minimum of 10 linear feet of joints in cast-in-place concrete.
 - 1. Apply mock-up with specified joint filler types and with other components noted.
 - 2. Locate where directed by Architect.
 - 3. Mock-up may remain as part of work if acceptable to architect.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original factory packaging bearing identification of product, manufacturer, and batch number. Provide Material Safety Data Sheets for each product.

- B. Store products in a location protected from freezing, damage, construction activity, precipitation, and direct sunlight in strict accordance with manufacturer's recommendations.
- C. Condition products to approximately 60 to 70 degrees F for use in accordance with manufacturer's recommendations.
- D. Handle all products with appropriate precautions and care as stated on Material Safety Data Sheet.

1.6 PROJECT CONDITIONS

- A. Do not use products under conditions of precipitation or freezing weather. Use appropriate measures for protection and supplementary heating to ensure proper curing conditions in accordance with manufacturer's recommendations if application during inclement weather occurs.
- B. Ensure substrate is dry.
- C. Protect adjacent work from contamination due to mixing, handling, and application of flexible epoxy joint filler.

1.7 WARRANTY

- A. Installer's Warranty: Original statement on Installer's letterhead in which Installer agrees to repair or replace joint sealants that demonstrate deterioration or failure within warranty period specified.
- B. Warranty Period: Minimum two years from date of Substantial Completion.
- C. Special Manufacturer's Warranty: Manufacturer's standard form in which joint sealant manufacturer agrees to furnish joint sealants to repair or replace those that demonstrate deterioration or failure under normal use within warranty period specified.
- D. Warranty Period for Silicone Sealants: 20 years date of Substantial Completion.
- E. Warranties exclude deterioration or failure of joint sealants in normal use due to structural movement resulting in stresses on joint sealants exceeding sealant manufacturer's written specifications, joint substrate deterioration, mechanical damage, or normal accumulation of dirt or other contaminants.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers (Sealants and Joint Fillers):
 - 1. Sonneborn(R) Building Products, ChemRex, Inc., 889 Valley Park Drive, Shakopee, MN 55379-9897; ASD. Tel: (800) CHEMREX (243-6739).
 - 2. General Electric.
 - 3. Dow Corning.
 - 4. Pecora.
 - 5. Tremco.
 - 6. United States Gypsum.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01600.
- C. Provide all joint sealers of the same type from a single manufacturer.

2.2 MATERIALS

- A. General:
 - 1. VOC Content for Interior Applications: Provide sealants and sealant primers complying with the following VOC content limits per 40 CFR 59, Subpart D (EPA Method 24):
 - a. Architectural Sealants: 250 g/L.
 - b. Sealant Primers for Nonporous Substrates: 250 g/L.
 - c. Sealant Primers for Porous Substrates: 775 g/L.
 - 2. Low-Emitting Sealants for Interior Applications: Provide sealants and sealant primers complying 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. Two Component, Non-Sag Polyurethane Sealant:
Sonneborn(R)/ChemRex "Sonolastic(R) NP 2(tm)" with plus or minus 25 percent movement capability for vertical joints; ASTM C 920, Type M, Grade NS, Class 25; FS TT-S-00227E, Type II, Class A; Canadian Specification CAN/CGSB-19.24-M90, Classification MCG-2-40-A-N, No. 81029; USDA approved; SWRI validated; UL classified (fire resistance).
- C. Two Component, Self-Leveling Polyurethane Sealant:
Sonneborn(R)/ChemRex "Sonolastic(R) SL 2(tm)" with plus or minus 25 percent movement capability for horizontal joints; ASTM C 920, Type M, Grade P, Class 25; FS TT-S-00227E, Type I, Class A; Canadian Specification CAN/CGSB-19.24-M90, Classification MCG-1-40-B-L, No. 81031; USDA approved.

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- D. Silicone Sealant: ASTM C 920, Type S, Grade NS, Class 25, Use NT, A, and M; FS TT-S-001543 (COM-NBS); USDA approved.
- E. Poured Flexible Epoxy Joint Filler: Sonneborn(R)/ChemRex "Epolith(R)-P"; two component 100 percent solids epoxy joint filler with flexible, pourable, self-leveling properties.
 - 1. Shore A Hardness: 85 plus or minus 5.
 - 2. Shore D Hardness: 34.
 - 3. Elongation: 75 percent.
 - 4. Tensile Strength: 655 pounds per square inch (4.5 MPa) plus or minus 10 pounds per square inch (0.07 MPa).
 - 5. Mixing Ratio: 1 to 1 by volume.
 - 6. Pot Life: 40 to 55 minutes at 75 degrees F (24 degrees C).
 - 7. Cure Time, Foot Traffic: 4 hours.
 - 8. Cure Time, Vehicular Traffic: 24 hours.
 - 9. Application Temperature: Minimum 55 degrees F (13 degrees C).
- F. Gunned Flexible Epoxy Joint Filler: Sonneborn(R)/ChemRex "Epolith(R)-G"; two component 100 percent solids, gun-grade epoxy joint filler with flexible, pick-proof properties for sloped areas.
 - 1. Shore A Hardness: 90 plus or minus 5.
 - 2. Shore D Hardness: 50.
 - 3. Elongation: 50 percent.
 - 4. Tensile Strength: 900 pounds per square inch (6.2 MPa) plus or minus 10 pounds per square inch (0.07 MPa).
 - 5. Slant Shear Strength: 865 pounds per square inch (6.0 MPa) per ASTM C 882.
 - 6. Slant Shear Strength: 112 pounds per square inch (0.8 MPa) per ASTM C 321.
 - 7. Mixing Ratio: 1 to 1 by volume.
 - 8. Pot Life: 40 to 55 minutes at 75 degrees F (24 degrees C).
 - 9. Cure Time, Foot Traffic: 4 hours.
 - 10. Cure Time, Vehicular Traffic: 24 hours.
 - 11. Application Temperature: Minimum 55 degrees F (13 degrees C).

2.3 ACCESSORIES

- A. Low VOC Primer: Sonneborn(R)/ChemRex "Primer No. 766," solvent based.
- B. Joint Cleaner: Sonneborn(R)/ChemRex "REDUCER 990"; non-corrosive and non-staining.
- C. Soft Backer Rod: Sonneborn(R)/ChemRex "Sonofoam Soft Backer Rod"; non-gassing, reticulated closed-cell polyethylene rod designed for use with cold-applied joint sealants.
 - 1. Comply with ASTM C 1330.
 - 2. Size required for joint design.

- D. Closed-Cell Backer Rod: Sonneborn(R)/ChemRex "Sonofoam Closed-Cell Backer Rod"; closed-cell polyethylene rod designed for use with cold-applied joint sealants for on-grade or below-grade applications.
 - 1. Comply with ASTM C 1330.
 - 2. Size required for joint design.
- E. Joint Filler: Sonneborn(R)/ChemRex "Expansion Joint Filler"; closed-cell polyethylene joint filler designed for use in cold joints, construction joints, or isolation joints wider than 1/4 inch (6 mm).
 - 1. Size required for joint design.
- F. Bond Breaker: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

2.4 COLOR

- A. Sealant Colors: Selected by architect from the manufacturer's master color system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspect all areas involved in work to establish extent of work, access, and need for protection of surrounding construction.
- B. Protect all surroundings from flexible epoxy joint filler including, but not limited to, floors, equipment, line striping, walkways, and drives.
- C. Conduct preapplication inspection of site verification with an authorized manufacturer's representative.

3.2 PREPARATION

- A. Remove loose materials and foreign matter which impair adhesion of joint filler.
- B. Clean joints and saw cuts by grinding, sandblasting, or wire brushing to expose a sound surface free of contamination and laitance.
- C. Ensure structurally sound surfaces, dry, clean, free of dirt, moisture, loose particles, oil, grease, asphalt, tar, paint, wax, rust, waterproofing, curing and parting compounds, membrane materials, and other foreign matter.

- D. Where the possibility of joint filler staining of adjacent areas or materials exists, mask joints prior to application.
 - 1. Do not remove masking tape before joints have been tooled and initial cure of joint filler has taken place.
 - 2. Work stained due to failure of proper masking precautions will not be accepted.

3.3 INSTALLATION

- A. Back-Up Material:
 - 1. Install appropriate size backer rod, larger than joint where necessary according to manufacturer's recommendations.
 - 2. Install polyethylene joint filler in joints wider than 1/4 inch (6 mm) to back-up material per manufacturer's recommendations.
 - 3. Do not install epoxy joint filler over backer rod.
- B. Bond Breaker: Install bond-breaker strip in joint to be sealed on top of back-up material to prevent adhesion of sealant to back-up material; install per manufacturer's recommendations.
- C. Sealant:
 - 1. Prepare sealants that require mixing; follow manufacturer's recommended procedures, mixing thoroughly.
 - 2. Mix only as much material as can be applied within manufacturer's recommended application time period.
 - 3. Apply materials in accordance with manufacturer's recommendations; take care to produce beads of proper width and depth, tool as recommended by manufacturer, and immediately remove surplus sealant.
 - 4. Apply materials only within manufacturer's specified application life period. Discard sealant after application life is expired or if prescribed application period has elapsed.
- D. Epoxy Joint Filler:
 - 1. Transfer entire contents of activator container thoroughly with entire contents of base container in separate container of appropriate size.
 - 2. Mix only as much material as can be applied within manufacturer's recommended application time period.
 - 3. Mix with slow-speed drill (80-100 rpm) and slotted paddle. Ensure mixing paddle reaches bottom and scrapes side of container several times. Scrape paddle several times to ensure thorough mixing. Keep paddle blade below surface to avoid whipping air into material.
 - a. Mix Epolith(R)-P for 5 to 7 minutes.
 - b. Mix Epolith(R)-G for 8 to 10 minutes.
 - 4. Pour Epolith(R)-P from spouted can or professional bulk-loading caulking gun.

5. Apply Epolith(R)-G by professional bulk-loading gun.
6. Maintain minimum joint application of 2/3 joint depth or 1 inch (25 mm), whichever is greater.
7. Fill joints from bottom up to exterior face by holding properly sized nozzle against joint bottom.
8. Tool joint to ensure maximum adhesion to joint sides, correct bead configuration, and a neat joint. Dry tool or dampen tool with Reducer 990. Do not use water or soapy water.
9. Apply materials only within manufacturer's specified application life period. Discard joint filler after application life is expired or if prescribed application period has elapsed.

3.4 CLEANING

- A. Remove uncured sealant and joint filler with Reducer 990, xylene, toluene, or MEK. Remove cured sealant and joint filler by razor, scraping, or mechanically.
- B. Remove all debris related to application of sealants from job site in accordance with all applicable regulations for hazardous waste disposal.

3.5 SCHEDULE OF JOINT SEALERS

- A. General-Purpose Interior and Exterior Applications:
 1. Sealant:
 - a. Two component polyurethane.
 2. Applications:
 - a. Joints and recesses between adjacent constructions and frames, sills, and subsills of windows, doors, curtainwall, storefront, and louvers.
 - b. Coping joints and wash joints in precast concrete, cast stone, or natural stone.
 - c. Masonry joints beneath shelf angles.
 - d. Around penetrations in exterior walls.
 - e. Under door thresholds and at bottom of door frames.
 - f. Where necessary to prevent infiltration of water or air into or through exterior building envelope.
- B. Other Exterior Applications:
 1. Sealant:
 - a. Two component polyurethane.
 2. Applications:
 - a. Between adjacent construction and gravel stops, copings, fascias, and miscellaneous flashings.
 - b. Metal flashings inserted into reglet.
 - c. Top edges of surface mounted counterflashing.
 - d. Expansion and control joints in masonry where expansion joint covers are not indicated.
 - e. Joints between new and existing exterior construction.

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- C. Interior Wetted Areas:
 - 1. Sealant: Silicone.
 - 2. Applications: Between adjacent construction and vanities, shower stalls, bathtub and shower enclosures, sinks, counter tops, plumbing cut-outs, and plumbing fixtures.
- D. Interior High-Movement Joints:
 - 1. Sealant:
 - a. Two component polyurethane.
 - 2. Applications:
 - a. At resilient joint between interior partitions and floor framing above.
- E. Other Interior Applications:
 - 1. Sealant:
 - a. Two component polyurethane.
 - 2. Applications:
 - a. Between adjacent construction and equipment, shelving, casework, and furniture.
 - b. Perimeters of door and window frames, access panels.
 - c. Between interior partitions and adjoining concrete or steel columns, walls, or other construction.
 - d. Other exposed locations within partitions to seal against passage of air.
 - e. Other interior joints of small dimension which require painting.
 - f. Gypsum board partitions:
 - 1) Between gypsum panels and metal track at floors and dissimilar walls; install sealant just prior to installation of gypsum panel.
 - 2) Between adjacent face layers of abutting intersection gypsum board partitions; install sealant before taping and finishing joint.
 - 3) Between gypsum panels and penetrations: Seal around openings of ducts and pipes. Seal sides and backs of electrical boxes.
 - 4) Seal control joints prior to installing control joint trim.
 - g. Other concealed locations within partitions to completely seal against passage of air.
 - 3. Allow sealant to cure before painting over joint.
- F. Exterior Traffic Surfaces:
 - 1. Sealant:
 - a. Two component self-leveling polyurethane.
 - b. Single component self-leveling polyurethane.
 - 2. Applications:
 - a. Control and expansion joints in sidewalks and pavements.

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- G. Interior Traffic Surfaces:
 - 1. Sealant:
 - a. Two component self-leveling polyurethane.
 - 2. Applications:
 - a. Control and expansion joints in floors.
- H. Interior Heavy Traffic Surfaces:
 - 1. Surface preparation: Freshly saw-cut or blast-clean joints; blow with oil-free compressed air.
 - 2. Sealant: Epoxy Joint Filler.
 - a. Pour flush with adjacent surface in 2 pours in accordance with manufacturer's instructions.
 - 3. Applications: Control joints in floors subject to vehicular traffic.
- I. Glazing:
 - 1. Primer: None.
 - a. Glass (non-coated).
 - b. Ceramic tile, quarry tile.
 - 2. Primer:
 - a. Aluminum (anodized and mill finish).
 - b. Iron and steel (carbon, stainless, galvanized).
 - c. Plastic (ABS, PVDF, polyurethane, PVC).
 - d. Wood.
 - e. Marble, slate.
 - f. Concrete.
 - 3. Sealant:
 - a. Silicone.
 - 4. Applications:
 - a. Glazing, including butt and lap sheer joints, stopless glazing, and cap, head and toe bead in conventional glazing.
 - b. Curtain wall.
 - c. Storefront.
 - d. Skylights.

END OF SECTION

SECTION 07 95 13

EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Joint cover for expansion and other building movement.

1.2 RELATED WORK

- A. Preparation of joint, setting of joint cover into adjacent work, non-shrink grout for block outs, and adjacent finishes.

1.3 SYSTEM DESCRIPTION

- A. Joint covers shall permit unrestrained movement of joint without disengagement of cover.
- B. Provide watertight expansion control system that is capable of accommodating multi-directional movement. System shall consist of preformed thermoplastic rubber profiles with integral side flanges typically cast into a preformed blockout by means of utilizing manufacturer's ambient cure elastomeric header.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Submit shop drawings and product data indicating joint cover profile details, dimensions, locations within the work, affected adjacent construction, anchorage, finishes, splices, and accessories.
- C. Manufacturer's Installation Instructions: Indicate rough-in sizes. Provide templates for cast-in or placed frames or anchors, and indicate tolerances for item placement.

1.5 FIELD MEASUREMENTS

- A. Verify that field measurements are as instructed by the manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Provide temporary protective cover on finished surfaces.

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PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Watson Bowman Acme Corp., 95 Pineview Drive, Amherst, NY 14228
Ph: (716) 691-7566 Fax: (716) 691-9239 www.wbacorp.com
- B. EMSEAL Joint Systems Ltd., 25 Bridle Lane, Westborough, MA 01581-
2603 Ph: 800-526-8365 Fax: 508-836-0281 Email:
techinfo@emseal.com, www.emseal.com
- C. Substitutions: Under the provisions of Section 01 60 00.

2.2 MATERIALS

- A. General:
 - 1. Provide watertight expansion control system in horizontal applications that is capable of accommodating multi-directional movement. System shall consist of preformed thermoplastic rubber profiles with integral side flanges typically cast into a preformed blockout by means of utilizing manufacturer's ambient cure elastomeric header.
 - a. The thermoplastic rubber seal element shall be sized to accommodate the total range of movement as dictated by the specifier at each joint location. Sizing shall be made in such a way as to ensure that the elastomeric membrane seal will remain under a degree of compression throughout the full movement cycle. Where required, provide seal that accepts pedestrian traffic. The contractor will provide evidence utilizing manufacturer's product data that the membrane seal will comply with this requirement.
 - 2. Provide watertight, energy-efficient exterior and interior joints in vertical-plane walls (above-grade). Locations may include, but are not limited to the following: panel to panel joints, control joints, or structural expansion joints, all as indicated on the drawings.
- B. Horizontal Thermoplastic Rubber Joint Seals (Elastomeric Seal) – Wabo®Crete Membrane – ME Series as manufactured by Watson Bowman Acme Corp.
 - 1. Provide seal profile as specified and indicated in the contract drawings. Profile design shall incorporate integral side flanges exhibiting a pronounced serrated profile and factory punched holes that interlocks the profile into the elastomeric header material. Material shall meet the physical and performance properties indicated below:

| <u>PHYSICAL PROPERTIES</u> | <u>ASTM TEST METHOD</u> | <u>REQUIREMENT</u> |
|----------------------------|-------------------------|--------------------|
| Shore A Hardness | D-2240 | 67 ± 3 |

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| | | |
|-------------------------------------|-------|----------------|
| Tensile Strength, min | D-412 | 850 psi |
| Ultimate Elongation, min | D-412 | 300% |
| 100% Modulus | D-412 | 435 psi |
| Tension set, average | D-412 | 10% |
| Tear strength, average | D-624 | 140 pli @ 73°F |
| | | 58 pli @ 212°F |
| Compression Set, average, 168 hours | D-395 | 23% @ 73°F |
| Brittle point, average | D-746 | < -76°F |

| <u>PERFORMANCE PROPERTIES</u> | <u>TEST METHOD</u> | <u>REQUIREMENT</u> |
|--------------------------------------|---------------------------|---------------------------|
| Ozone Resistance | ASTM D-1171 | No Cracks |
| UV Resistance | SAE J1960 | Pass |
| Staining Resistance | ASTM D-925 | No Staining |
| Fatigue Resistance | ASTM D-1052 | 2 Million Cycles |

2. **Elastomeric Header**

- a. Material shall be an ambient cure, 100% solids, two-component polyurethane with pregraded aggregate mix exhibiting the physical properties listed in the tables below. When properly mixed and poured, the elastomeric concrete cures rapidly, flows and fills any voids, spalls or irregularities forming a monolithic unit.
- b. Elastomeric cured binder shall meet the following physical properties:

| <u>PHYSICAL PROPERTIES</u> | <u>ASTM TEST METHOD</u> | <u>REQUIREMENT</u> |
|--------------------------------------|--------------------------------|---------------------------|
| Tensile Strength, min | D-638 | 750 psi |
| Ultimate Elongation, min | D-638 | 150% |
| Hardness, Shore D | D-2240 | 40 +/- 10 |
| Compression Set, 22 hr at 158°F, max | D-395, Method B | 50% |
| Tear Resistance, min | D-624 | 80 pli |
| Water Absorption, max | D-570 | 3% |
| Heat Shrinkage | D-1299 | 1.6% |

3. **Bonding Agent.**

- a. Provide manufacturer's two component, 100 percent solids bonding agent and apply to the sides and base of the preformed blockouts prior to placement of Wabo®Crete II elastomeric header. Store, mix and apply in accordance with manufacturer's system data sheet.
 - 1) Liquid components shall be identified by the following information:
 - a) Part A - Resin; Color: Clear
 - b) Part B - Activator; Color: Tan.

C. **Silicone-Coated, Pre-Compressed, Primary and Secondary Wall Seal – COLORSEAL as manufactured by EMSEAL Joint Systems.**

1. Preformed sealant shall be silicone pre-coated, preformed, pre-compressed, self-expanding, sealant system. Expanding foam to be cellular foam impregnated with a water-based, non-drying, 100% acrylic dispersion. Seal shall combine factory-applied, low-modulus silicone and a backing of acrylic-impregnated expanding foam into a unified hybrid sealant system.

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2. Material shall be capable of movements of +25%, -25% (50% total) of nominal material size
 3. Silicone external color facing to be factory-applied to the foam while it is partially pre-compressed to a width greater than maximum joint extension and cured before final compression. When compressed to final supplied dimension, a bellows to handle movement must be created in the silicone coating.
- D. Accessories - Provide necessary and related parts with appropriate anchors and sealants where required for complete installation.

2.3 FABRICATION

- A. Thermoplastic Rubber Membrane Seal - Ship in the longest practical continuous length in manufacturer's standard shipping carton or on wooden pallets shrink wrapped.
- B. Joint Seal Directional Changes - At all horizontal changes in direction provide seals with factory heat welded splices such as 90° corners, tees and crosses. The seal shall extend a minimum of 2'-0" in each direction from the factory splice.
1. Only straight, butt splice connections shall be allowed on the jobsite following manufacturers written instructions utilizing specialty heat fusing equipment or the manufacturer specialty-splicing adhesive.
 2. All factory and field fused connections shall incorporate bonding of the complete seal profile. This includes fusing of all internal and external web configurations. Fire Rated Joint Covers: Metaflex™ type shall have fire barrier and flame sealant to provide required fire rating.
- C. Elastomeric Header - Activator packaged in one-half gallon containers (Part A), resin packaged in gallon containers (Part B) and 60 pound containers of aggregate (Part C) on shipped wooden pallets, shrink wrapped.
- D. Silicone-Coated Wall Seal - must be supplied precompressed to less than the joint size, packaged in shrink-wrapped lengths (sticks) with a mounting adhesive on one face.
1. Directional changes and terminations into horizontal plane surfaces to be provided by factory-manufactured universal-90-degree single units containing minimum 12-inch long leg and 6-inch long leg or custom leg on each side of the direction change or through field fabrication in strict accordance with installation instructions.

2.4 FINISHES

- A. Thermoplastic Rubber Membrane Seal shall be supplied in standard color: Black.
- B. Elastomeric Header material shall be supplied in standard color: Black.
- C. Silicone-Coated Wall Seal shall be provided in the following colors:
 - 1. “Precora 890NST Anodized Aluminum” color for vertical applications and exterior horizontal applications where indicated on the drawings.
 - 2. “Precora 890NST Tru White” for interior horizontal applications where indicated on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions under provisions of Section 01 30 00.
- B. Verify that field measurements and block out dimensions are as shown on shop drawings.

3.2 PREPARATION

- A. The contractor shall clean the joint opening of all contaminants immediately prior to installation of expansion joint system. Repair spalled, irregular or unsound joint surfaces using accepted industry practices for repair of the substrates in question. Remove protruding roughness to ensure joint sides are smooth. Ensure that there is sufficient depth to receive the full depth of the size of the product being installed plus at least ¼-inch (6mm) for the application of corner beads, as occurs.
- B. Provide anchoring devices for installation and embedment as required for each product.
- C. Provide templates and rough-in measurements.

3.3 INSTALLATION

- A. Install joint covers to manufacturer’s instructions. Align work plumb, level, and flush with adjacent surfaces. Rigidly anchor to substrate. Make allowances for change in joint size due to difference between installation and building operating temperatures.
- B. Water Barrier: Provide water barriers at exterior joints and where called for on Drawings. Provide drainage fittings where called for on Drawings.

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3.4 ADJUSTING AND PROTECTION

- A. Adjust joint cover to freely accommodate joint movement.
- B. Protect installation from damage by work of other Sections. Where required, remove and store cover plate and install temporary protection over joints; reinstall cover plate before completion of work.
- C. Subsequent damage to the expansion joint system, as occurs, will be repaired at the general contractor's expense.
- D. After work is complete, clean exposed surfaces with a suitable cleaner that will not harm or attack the finish.

3.5 SCHEDULE

- A. The following is a schedule of expansion joint assemblies required for the Project. Refer to the Drawing for location.
 - 1. Floor Expansion Joint Cover: #ME-225 as manufactured by Watson Bowman Acme Corp.
 - 2. Floor-to-Wall Expansion Joint Cover: #ME-225C as manufactured by Watson Bowman Acme Corp.
 - 3. Horizontal Wall Expansion Joint Cover: COLORSEAL as manufactured by EMSEAL Joint Systems.

END OF SECTION

SECTION 08 11 10

STANDARD STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SCOPE

- A. Specifications apply to steel doors, steel door frames, door hardware and steel frame components such as sidelites, borrowed lites, transom frames and architectural stick assemblies as shown on Drawings and schedules.

1.2 REFERENCES

- A. ASTM E152 - Method of Fire Tests of Door Assemblies.
- B. DHI - Installation Guide for Doors and Hardware.
- C. NFPA 80 - Fire Doors and Windows.
- D. NFPA 252 - Fire Tests for Door Assemblies.
- E. SDI-100 - Standard Steel Doors and Frames.
- F. SDI-105 - Recommended Erection Instructions for Steel Frames.
- G. UL 10B - Fire Tests of Door Assemblies.
- H. ANSI A151.1 - Endurance Test.
- I. ANSI 115 - Hardware Preparation.

1.3 QUALITY ASSURANCE

- A. Conform to requirements of SDI-100, ANSI A151.1, and other specifications herein named. Test reports shall be submitted upon request.
- B. Acoustical qualities: Doors shall have a minimum sound transmission classification of 29 as tested under ASTM E-90-61T.
- C. Insulation properties: Doors shall have a U factor honeycomb core .41 (R factor of 2.4), styrene .12 (R factor 7.8).
- D. Underwriters' Laboratories and Warnock Hersey, labeled fire doors and frames:

1. All labeled fire doors and frames shall be of a type which has been investigated and tested in accordance with UL-10(b), ASTM E-152, NFPA 252, and ANSI A2.2.
2. Underwriters' Laboratories labeled doors and frames shall be manufactured under the UL factory inspection program and in strict compliance to UL procedures, and shall provide a degree of fire protection, heat transmission and panic loading capability indicated by the opening class.
3. Warnock Hersey labeled doors and frames shall be manufactured to meet the specific requirements of that labeling agency's current procedure for the tested hourly rating designated and shall be subject to inspection by representatives of the labeling agency.
4. A physical label or approved marking shall be affixed to the fire door or fire door frame at an authorized facility as evidence of compliance with procedures of the labeling agency.

1.4 REGULATORY REQUIREMENTS

- A. Doors and frames shall conform to applicable codes for fire ratings. All interior vertical stairwell doors shall carry a minimum 450°F temperature rise rating in addition to the required fire rating.

1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Indicate frame configuration, anchor types and spacings, location of cutouts for hardware, reinforcement, and finish.
- C. Indicate door elevations, internal reinforcement, closure method, and cutouts for glazing.
- D. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

1.6 DELIVERY, STORAGE AND PROTECTION

- A. Storage of Doors
 1. Doors shall be stored in an upright position under cover. Place the units on at least 4 inch wood sills on floors in a manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create a humidity chamber and promote rusting. If the corrugated wrapper on the door becomes wet, or moisture appears, remove the wrapper immediately. Provide a 1/4 inch space between the doors to promote air circulation.
- B. Storage of Frames
 1. Frames shall be stored under cover on 4 inch wood sills on floors in a manner that will prevent rust and damage. Do not use non-

vented plastic or canvas shelters, which create a humidity chamber and promote rusting. Assembled frames shall be stored in a vertical position, five unit's maximum in a stack. Provide a 1/4 inch space between frames to promote air circulation.

PART 2 PRODUCTS

2.1 DOOR MANUFACTURERS

- A. Hollow Metal Doors - Steelcraft.
- B. Other acceptable manufacturers offering equivalent products:
 - 1. Ceco
 - 2. Amweld
 - 3. Pioneer
 - 4. Curries
- C. Substitutions: Under provisions of Section 01 60 00.

2.2 MATERIALS

- A. Doors, frames and frame components shall be manufactured from hot-dipped galvanized steel having an A60 zinc coating conforming to ASTM specification A924. Galvanized steel shall be treated to insure proper paint adhesion. All component parts used in galvanized doors and/or frames shall meet the galvanize specification.

2.3 DOORS

- A. Exterior doors shall be Series L16.
- B. Interior doors shall be Series L18.
- C. Construction of Doors
 - 1. Doors shall be full-flush seamless construction, fabricated from hot-dipped galvanized steel.
 - 2. Interior Doors: Doors shall be reinforced, stiffened, sound deadened and insulated with impregnated Kraft honeycomb core completely filling the inside of the doors and laminated to inside faces of both panels using contact adhesive applied to both panels and honeycomb core.
 - 3. Exterior Doors: Doors shall be reinforced, stiffened, sound deadened and insulated with polystyrene insulation core completely filling the inside of the doors and laminated to inside faces of both panels using contact adhesive applied to both panels and polystyrene core.
 - 4. Door shall have continuous vertical mechanical interlocking joints at lock and hinge edges with edge seam filled and ground

- smooth. The internal portion of the seam shall be sealed with epoxy. An intermittent fastening along the seam is not permitted.
5. Doors shall have beveled 1/8 inch in 2 inches hinge and lock edges.
 6. Top and bottom steel reinforcement channels shall be 14-gauge and spot welded to both panels.
 7. Hinge reinforcements shall be 7-gauge. Lock reinforcements shall be 16-gauge and closer reinforcement 14-gauge box minimum 20 inches long. Hinge and lock reinforcements shall be projection welded to the edge of the door. Galvanized doors shall have galvanized hardware reinforcements. Adequate reinforcements shall be provided for other hardware as required.
 8. Glass trim for doors with cutouts shall be 24-gauge steel conforming to ASTM A 924 hot dipped galvanized steel with a zinc coating of 0.06 ounces per square foot. The trim shall be installed into the door as a four sided welded assembly. The trim shall fit into a formed area of the door face, shall not extend beyond the door face and shall interlock into the recessed area. The corners of the assembly shall be mitered, and shall be reinforced and welded. The trim shall be the same on both sides of the door. Exposed fasteners shall not be permitted. Label and non-label doors shall use the same trim.
 9. All exterior swing-out doors shall have the tops closed to eliminate moisture penetration. Door tops shall not have holes or openings. Top caps are permitted.
- D. Temperature Rise Doors
1. Temperature rise doors shall be the same as flush door construction except core material shall be designed to produce the 450°F degree temperature rise rating.

2.4 FRAMES

- A. Exterior frames shall be F14.
- B. Interior frames shall be F16.
- C. Construction of Frames
1. Flush frames shall be formed from 16 or 14-gauge galvanized steel as specified above.
 2. Frames shall have 2 inch faces.
 3. Frames shall be set-up and arc-welded. Miter corners shall have reinforcements with four integral tabs for secure and easy interlocking jambs to head.
 4. 14-gauge frames shall be supplied with factory installed inserted type rubber bumpers, (3) per strike jamb and (2) per head, for pair of doors. Stick on bumpers shall not be permitted. 12-gauge frames shall be supplied with loose pressure sensitive bumpers for field application.

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5. Frames shall have 7-gauge steel hinge reinforcements. Strike reinforcements shall be 16-gauge and prepared for an ANSI-A115.1-2 strike.
6. Metal plaster guards shall be provided for all mortised cutouts.
7. All hinge and strike reinforcements shall be projection welded to the door frame.
8. Reinforcements for surface closer shall be 14-gauge steel. Adequate reinforcements shall be provided for other hardware when required.
9. Galvanized frames shall have galvanized hardware reinforcements.
10. Frames shall be furnished with a minimum of six wall anchors and two adjustable base anchors of manufacturer's standard design.

D. Drywall Frames

1. Drywall frames shall be the same as flush frames except:
 - a. Frames shall be formed with double return backbends to prevent cutting into drywall surface.
 - b. Each jamb shall have an adjustable anchor located 4 inches from the top of the door opening to hold frame in rigid alignment. Frames shall have a welded-in base anchor attaching plate in each jamb for field installation of loose base anchors or frames shall have two (2) dimpled holes in each jamb for anchoring base of frame with screws.

E. Construction of Architectural Stick Components

1. Architectural stick frame assemblies shall be made of standard frame components, fabricated from 14-gauge galvanized steel. Where sticks are used at door openings and frame assemblies, they shall be prepared for hardware as specified.
2. Frame assemblies shall be fabricated from three basic components: Open Sections (perimeter members), closed sections (intermediate members), and sill sections. Open sections shall be identical in configuration to standard frames. Closed sections shall have identical jamb depths, face dimensions and stops as open sections. Closed sections shall be factory assembled and shall have full length internal reinforcement of 16-gauge steel, factory spot-welded to both soffits 8 inches on center. Sill sections shall be fabricated from galvanized steel and shall be either flush with both faces of adjacent vertical members or recessed from one and shall be either flush with both faces of adjacent vertical members or recessed from one face of the adjacent vertical members. Individual components shall be cut to length and notched to assure square joints and corners. All joints and corners of the frame assembly shall be welded and ground smooth at the face of the sections. Frame assemblies shall be shipped to jobsite completely welded. Field joints shall be permitted only when the size of the total assembly exceeds shipping limitations. When frame assemblies are subjected to

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windloads, vertical members shall be free of field splices. When specified, steel panels shall be furnished 1-3/8 inches thick. 1-3/8 inch panels shall be made of 20-gauge cold-rolled steel faces with a honeycomb core. Cores shall be laminated to inside faces of both panels. Steel channel glazing beads shall be provided with assemblies for all areas in which glass or panels are to be installed.

3. Glazing beads shall be cut to size and screws set in place ready to receive glazing.
4. All necessary anchors for jambs, heads and sills of assemblies shall be provided. When verification of field dimensions is necessary, they shall be made by the general contractor. Frame fabrication shall not begin until these dimensions have been submitted.

2.5 PROTECTIVE COATINGS

- A. The inside of all frames to be fully grouted shall be coated with a fibered asphalt coating. Coating shall be field applied by the contractor to a minimum 1/16 inch thickness.

2.6 FABRICATION

- A. Frames shall be supplied:
 1. Set up with faces arc-welded and ground smooth. Miters of frames shall be back welded. Weld shall penetrate the outside face. Faces shall be dressed smooth. Filler materials are not permitted.

2.7 FINISH

- A. All doors, frames and frame components shall be cleaned, phosphatized and finished as standard with one coat of baked-on rust inhibiting prime paint in accordance with the ANSI A224.1 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames".

PART 3 EXECUTION

3.1 INSTALLATION

- A. Doors and frames shall be installed in accordance with "Door and Hardware Institute" publication, "Installation Guide for Doors and Hardware" and/or Steelcraft installation instructions.
- B. Label doors and frames shall be installed per NFPA-80.

END OF SECTION

**SECTION 08 33 23
OVERHEAD COILING DOORS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Overhead coiling door, operating hardware, electric operation.
- B. Wiring from electric circuit disconnect to door operator to control station.

1.2 REFERENCES

- A. NEMA MG1 - Motors and Generators.
- B. UL - Fire Resistance Directory.

1.3 SYSTEM DESCRIPTION

- A. Electric motor operated unit with manual override in case of power failure.
- B. Coiling Door: Surface mounted.

1.4 DESIGN REQUIREMENTS

- A. Design door assembly to withstand wind/suction load of 20 psf, without undue deflection or damage to door or assembly components.
- B. Insulation Value: R of 6.33.

1.5 SUBMITTALS FOR REVIEW

- A. Section 01 33 00 - Submittals: Procedures for submittals.
- B. Product Data: Provide general construction, component connections and details, and electrical equipment.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

1.6 SUBMITTALS FOR INFORMATION

- A. Section 01 33 00 - Submittals: Procedures for submittals.
- B. Manufacturer's Instructions: Indicate installation sequence and procedures, and adjustment and alignment procedures.

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1.7 SUBMITTALS FOR CLOSE-OUT

- A. Section 01 70 00 - Contract Close-out: Procedures for submittals.
- B. Maintenance Data: Indicate lubrication requirements and frequency, and periodic adjustments required.

1.8 REGULATORY REQUIREMENTS

- A. Conform to applicable code for hour fire rated opening.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of door and operating hardware assembly.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com.
- B. Other acceptable manufacturers offering equivalent products:
 - 1. The Cookson Company, 800 Tulip Drive, Gastonia, NC 28052.
 - 2. Cornell Iron Works, Crestwood Industrial Park, Mountaintop, PA 18707.
 - 3. Raynor Garage Door, PO Box 448, East River Road, Dixon, IL 61021.
 - 4. Wayne Dalton Corp., Mt. Hope, Ohio 44660.
- C. Substitutions: Refer to Section 01 60 00.

2.2 MATERIALS - INSULATED DOOR

- A. Overhead Coiling Stormtite Insulated Service Door, 625 Series as manufactured by Overhead Door Corporation.
- B. Curtain
 - 1. Slats: Interlocking roll-formed slats.
 - a. Flat profile type F-265i for doors up to 40 feet (12.19 m) wide.
 - b. Front slat fabricated of 20 gauge galvanized steel.
 - c. Back slat fabricated of 24 gauge galvanized steel.

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- d. Slat cavity filled with CFC-free foamed-in-place, polyurethane insulation, R-Value: 7.7, U-Value: 0.13, Sound Rating: STC-21.
 - e. Finish: PowderGuard® Premium weather-resistant polyester powder coat color as selected by the Architect from manufacturer's standard colors.
 - f. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.
- C. Weatherseals:
 - 1. Vinyl bottom seal, exterior guide and internal hood seals.
 - 2. Interior guide weatherseal.
 - 3. Lintel weatherseal.
- D. Bottom Bar: Two stainless steel angles minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.
- E. Guides:
 - 1. Three Structural steel angles.
 - 2. Finish: PowderGuard Zinc Finish for guides, bottom bar and head plate.
- F. Counterbalance Assembly:
 - 1. Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel.
- G. Hood:
 - 1. Provide with internal hood baffle weatherseal.
 - 2. 24 gauge galvanized steel with intermediate supports as required.
- H. Brackets
 - 1. Plain steel plate not less than 3/16" thick.
 - 2. Ball bearings at rotating support points.
 - 3. Bolted to guide wall angle extension, supports counterbalance assembly and forms end closures.
- I. Operation:
 - 1. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.
 - a. Sensing Edge Protection:
 - 1) Electric sensing edge.
 - b. Operator Controls:
 - 1) Push-button operated control stations with open, close, and stop buttons.
 - 2) Controls for interior location.

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- 3) Controls surface mounted.
- c. Special Operation:
 - 1) Radio control operation.
 - (a) Provide (60) sixty radio transmitters with Open/Close/Stop operation.
- d. Motor Voltage: 115/230 single phase, 60 Hz.
- 2. Windload Design:
 - a. Standard windload shall be 20 PSF.
- 3. Locking:
 - a. Interior slide bolt lock for electric operation with interlock switch.
- 4. Wall Mounting Condition:
 - a. Face-of-wall mounting.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 – Administrative Procedures: Verification of existing conditions before starting work.
- B. Verify that opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION

- A. Install door unit assembly in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Division 26 - Electrical. Complete wiring from disconnect to unit components and from fire alarm system to door operator as required.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 92 00.
- G. Install perimeter trim and closures.

3.3 ERECTION TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.

- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.4 ADJUSTING

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust door hardware and operating assemblies for smooth and noiseless operation.

3.5 CLEANING

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

SECTION 08 41 13

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Entrance and storefront systems, complete with reinforcing, fasteners, anchors and attachment devices.
 - 2. Aluminum doors complete with hardware.
 - 3. Accessories necessary to complete work.

1.2 REFERENCES

- A. Aluminum Association (AA):
 - 1. DAF-45 Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. 503.1 Test Method for Condensation Resistance of Windows, Doors and Glazed Wall Systems.
 - 2. 605.2-92 Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
 - 3. 607.1 Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
 - 4. 608.1 Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.
 - 5. 701.2 Specifications for Pile Weatherstripping.
 - 6. Manual #10 Care and Handling of Architectural Aluminum From Shop to Site.
 - 7. SFM-1 Aluminum Storefront and Entrance Manual.
- C. American National Standards Institute (ANSI):
 - 1. A117.1 Safety Standards for the Handicapped.
- D. American Society for Testing and Materials (ASTM):
 - 1. A36 Structural Steel.
 - 2. B209 Aluminum and Aluminum - Alloy Sheet and Plate.
 - 3. B221 Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
 - 4. B308 Aluminum-Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded.
 - 5. C509 Cellular Elastomeric Pre-formed Gasket and Sealing Material.
 - 6. C864 Dense Elastomeric Compression Seal Gaskets, Setting Blocks and Spacers.

7. E283 Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.
8. E330 Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
9. E331 Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.

1.3 SYSTEM REQUIREMENTS

A. Design Requirements:

1. Drawings are diagrammatic and do not purport to identify nor solve problems of thermal or structural movement, glazing, anchorage or moisture disposal.
2. Requirements shown by details are intended to establish basic dimension of units, sight lines and profiles of members.
3. Provide concealed fastening.
4. Provide entrance and storefront systems, including necessary modifications, to meet specified requirements and maintaining visual design concepts.
5. Attachment considerations are to take into account site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening or fracturing connection between units and building structure or between units themselves.
6. Anchors, fasteners and braces shall be structurally stressed not more than 50% of allowable stress when maximum loads are applied.
7. Provide for expansion and contraction without detriment to appearance or performance.
8. Assemblies shall be free from rattles, wind whistles and noise due to thermal and structural movement and wind pressure.
9. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

B. Performance Requirements:

1. Air infiltration: Air leakage through fixed light areas of storefront shall not exceed 0.06 cfm per square foot of surface area when tested in accordance with ASTM E283 at differential static pressure of 6.24 psf.
2. Water infiltration: No uncontrolled water penetration when tested in accordance with ASTM E 331 at test pressure of 10.0 psf.

- C. Thermal Requirements:
 - 1. Framing systems shall accommodate expansion and contraction movement due to surface temperature differentials of 180 degrees Fahrenheit (82 degrees Celsius) without causing buckling, stress on glass, failure of joint seals, excessive stress on structural elements, reduction of performance, or other detrimental effects.
 - 2. Ensure doors function normally within limits of specified temperature range.
- D. Structural Requirements, as measured in accordance with ANSI/ASTM E330:
 - 1. Wind loads for exterior assemblies:
 - a. Basic loading:
 - 1) 25 psf acting inward.
 - 2) 25 psf acting outward.
 - 2. Deflection: Maximum calculated deflection of any framing member in direction normal to plane of wall when subjected to specified design pressures shall not exceed 1/175 of its clear span.
- E. Testing Requirements: Provide components that have been previously tested by an independent testing laboratory.

1.4 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00.
- B. Product Data:
 - 1. Submit manufacturer's descriptive literature and product specifications.
 - 2. Include information for factory finishes, hardware, accessories and other required components.
 - 3. Include color charts for finish indicating manufacturer's standard colors available for selection.
- C. Shop Drawings:
 - 1. Submit shop drawings covering fabrication, installation and finish of specified systems.
 - 2. Include following:
 - a. Fully dimensioned plans and elevations with detail coordination keys.
 - b. Locations of exposed fasteners and joints.
 - 3. Provide detailed drawings of:
 - a. Composite members.
 - b. Joint connections for framing systems and for entrance doors.
 - c. Anchorage.
 - d. System reinforcements.
 - e. Expansion and contraction provisions.

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- f. Hardware, including locations, mounting heights, reinforcements and special installation provisions.
 - g. Glazing methods and accessories.
 - h. Internal sealant requirements as recommended by sealant manufacturer.
- 4. Schedule of finishes.

D. Samples:

- 1. Submit samples indicating quality of finish, in required colors, on alloys used for work, in sizes as standard with manufacturer.
- 2. Where normal texture or color variations are expected, include additional samples illustrating range of variation.

E. Test Reports:

- 1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of re-testing. Include other supportive data as necessary.

F. Certificates:

- 1. Submit manufacturer's certification stating that systems are in compliance with specified requirements.

G. Qualification Data:

- 1. Submit installer qualifications verifying years of experience.
- 2. Include list of projects having similar scope of work identified by name, location, date, reference name and phone number.

H. Manufacturer's Instructions: Submit manufacturer's printed installation instructions.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility:

- 1. To ensure quality of appearance and performance, obtain materials for each system from either a single manufacturer or from manufacturer approved by each system manufacturer.

B. Installer Qualifications: Certified in writing by Contractor as qualified for installation of specified systems.

C. Perform Work in accordance with AAMA SFM-1 and manufacturer's written instructions.

D. Conform to requirements of ANSI A117.1 and local amendments.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of Section 01 60 00.
- B. Protect finished surfaces as necessary to prevent damage.
- C. Do not use adhesive papers or sprayed coatings which become firmly bonded when exposed to sun.
- D. Do not leave coating residue on any surfaces.
- E. Replace damaged units.

1.7 WARRANTY

- A. Provide warranties in accordance with Section 01 70 00.
- B. Provide written manufacturer's warranty, executed by company official, warranting against defects in materials and products for 2 years from date of Substantial Completion. Warrant door corner construction for the life of the project.
- C. Provide written installer's warranty, warranting work to be watertight, free from defective materials, defective workmanship, glass breakage due to defective design, and agreeing to replace components which fail within 2 years from date of Substantial Completion.
 - 1. Warranty shall cover following:
 - a. Complete watertight and airtight system installation within specified tolerances.
 - b. Completed installation will remain free from rattles, wind whistles and noise due to thermal and structural movement and wind pressure.
 - c. System is structurally sound and free from distortion.
 - d. Glass and glazing gaskets will not break or "pop" from frames due to design wind, expansion or contraction movement.
 - e. Glazing sealants and gaskets will remain free from abnormal deterioration or dislocation due to sunlight, weather or oxidation.
- D. Provide a written thermal integrity warranty for 10 years from date of Substantial Completion against thermal barrier system failure resulting from the following:
 - 1. Longitudinal and transverse thermal barrier shrinkage.
 - 2. Thermal barrier cracking.
 - 3. Structural failure of the thermal barrier material.
 - 4. Loss of adhesion or loss of prescribed edge pressure on glazing material resulting in excessive air and water infiltration.

PART 2 PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Subject to compliance with requirements indicated, provide products by one of the following:
 - 1. Kawneer North America, 555 Guthridge Ct., Norcross, GA 30092, (770) 449 5555 (voice), (770) 734 1560 (fax), www.kawneer.com
 - 2. United States Aluminum, 200 Singleton Drive, Waxahachie, Texas 75165; (972) 937-9651 (voice); (972) 937-0405 (data).
- B. Substitutions: Submit under provisions of Section 01 60 00.
- C. Basis-of Design Product; Entrance Doors:
 - 1. Kawneer Company Inc.
 - 2. 360 Insulclad Thermal Entrances
 - 3. 2-1/4" deep, with 4-1/16 inch vertical stile, 4-1/16 inch top and 7-1/16 inch bottom rail.
 - 4. Architects Classic push/pulls or Exit Device as noted in Hardware Schedule.
- D. Basis-of-Design Product; Frames:
 - 1. Kawneer Company Inc.
 - 2. EnCORE® Thermal Storefront System
 - 3. 1-3/4 inch (44.5 mm) x 6 inch (228.6 mm) nominal dimension, System Dimensions
 - 4. Glass: Exterior

2.2 MATERIALS

- A. 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.
- B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim hardware, anchors, and other components.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc

coating; provide sufficient strength to withstand design pressure indicated.

- E. Sealant: For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
- F. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 STOREFRONT FRAMING SYSTEM

- A. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- C. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- D. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- E. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
- E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:

1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.
 - a. Color: Black
2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
 - a. Color: Matching structural sealant.

2.5 ENTRANCE DOOR SYSTEMS

- A. Major portions of the door members to be 0.125" (3.2 mm) nominal in thickness and glazing molding to be 0.05" (1.3 mm) thick.
- B. Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.
- C. Provide adjustable glass jacks to help center the glass in the door opening.
- D. Door Hardware:
 1. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum-framed entrance doors.
 2. Standard Hardware:
 - a. Weatherstripping:
 - 1) Meeting stiles on pairs of doors shall be equipped with an adjustable astragal utilizing wool pile with polymeric fin.
 - 2) The door weathering on a single acting offset pivot or butt hung door and frame (single or pairs) shall be Kawneer Sealair® weathering. This is comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.
 - b. Sill Sweep Strips: EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners (Necessary to meet specified performance tests).
 - c. Threshold: Extruded aluminum, one piece per door opening, with ribbed surface.
 - d. Offset Pivots: Kawneer standard top and bottom pivots.

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- e. Push/Pull: Kawneer Architects Classic style CO-9 Pull and CP-II Push Bar.
- f. Exit Device: Dor-O-Matic/Falcon 1690 EL Standard Kawneer Device, with Architects Classic - Style CO-9 Exit Device Pulls.
- g. Closer: Norton 1601/1601 BF adjustable standard Kawneer closer.
- h. Security Lock/Dead Lock: Adams Rite MS-1850A-505 Hookbolt.

E. Fabrication:

- 1. Fabricate aluminum-framed glass entrance doors in sizes indicated. Include a complete system for assembling components and anchoring doors.
- 2. Fabricate aluminum-framed glass doors that are reglazable without dismantling perimeter framing.
- 3. Door corner construction shall consist of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8" (29 mm) long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type with EPDM glazing gaskets reinforced with non-stretchable cord.
- 4. Accurately fit and secure joints and corners. Make joints hairline in appearance.
- 5. Prepare components with internal reinforcement for door hardware.
- 6. Arrange fasteners and attachments to conceal from view.

F. Weather Stripping: Provide weather stripping locked into extruded grooves in door panels or frames as indicated on manufacture's drawings and details.

2.6 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) thickness per coat.

2.7 FABRICATION

- A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fit joints; make joints flush, hairline and weatherproof.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.

4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing.
 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- B. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- C. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- D. Storefront Framing: Fabricate components for assembly using manufactures standard installation instructions.
- E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing:
1. Kawneer Permanodic® AA-M12C22A41, AAMA 611, Architectural Class I Clear Anodic Coating (Color #14 Clear).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with Work in accordance with Section 01 40 00.
- B. Verify dimensions, tolerances and method of attachment with other Work.

3.2 INSTALLATION

- A. Erection Tolerances:
1. Limit variations from plumb and level:
 - a. 1/8 inch in 10 feet vertically.
 - b. 1/8 inch in 20 feet horizontally.
 2. Limit variations from theoretical locations: 1/4 inch for any member at any location.

3. Limit offsets in theoretical end-to-end and edge-to-edge alignment: 1/16 inch from flush surfaces not more than 2 inches apart or out-of-flush by more than 1/4 inch.
- B. Install doors and hardware in accordance with manufacturer's printed instructions.
- C. Set units plumb, level and true to line, without warp or rack of frame.
- D. Anchor securely in place, allowing for required movement, including expansion and contraction.
- E. Separate dissimilar materials at contact points, including metal in contact with masonry or concrete surfaces, with bituminous paint or pre-formed separators to prevent contact and corrosion.
- F. Seal perimeter members as shown on manufacturer's installation instructions or as required for unique job conditions. Set other members with internal sealants and baffles as called for in manufacturer's installation instructions. Use sealants as recommended by sealant manufacturer.
- G. Coordinate installation of perimeter sealant and backing materials between assemblies and adjacent construction in accordance with requirements of Section 07 92 00.
- H. Glazing: Refer to requirements of Section 08 81 00. Utilize "anti-walk" edge blocking on all vertical edges of glazing.

3.3 ADJUSTING

- A. Test door operating functions. Adjust closing and latching speeds and other hardware in accordance with manufacturer's instructions to ensure smooth operation.

3.4 CLEANING

- A. Clean surfaces in compliance with manufacturer's recommendations; remove excess mastic, mastic smears, foreign materials and other unsightly marks.
- B. Clean metal surfaces exercising care to avoid damage.

END OF SECTION

**NEW PARKING STRUCTURE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 084229.23 –SLIDING
AUTOMATIC ENTRANCES**

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. Sliding, bi-parting, power-operated automatic entrances including sliding doors, sidelites, side jambs, header with roller track. Operator, bottom door guides, and activation devices.
- B. Related Sections:
 - 1. Division 08 Section "Metal Fabrications" for miscellaneous metal framing and supports.
 - 2. Division 08 Section 084113 "Aluminum Entrances and Storefronts"
 - 3. Division 16 Sections for electrical connections including conduit and wiring for automatic entrance operators.

1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.
- C. IBC: International Building Code.
- D. Safety Device: Device that, to avoid injury, prevents a door from opening or closing.
- E. For automatic door terminology, refer to ANSI/BHMA A156.10 for definitions of terms.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide entrances meeting the requirements of ANSI/BHMA A156.10, American National Standard for Power Operated Doors.

- B. Structural Performance: Automatic entrances shall withstand the effects of gravity loads and wind loads within limits and under conditions indicated according to SEI/ASCE 7.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations 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.
- D. Operating Temperature Range: Provide automatic entrances that operate within minus 40 to plus 102 deg F.
- E. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. of fixed entrance system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..
- F. Opening-Force Requirements:
 - 1. Power-Operated Doors: Not more than 30 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.
 - 2. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for a breakaway door or panel to open.
- G. Entrapment Force Requirements:
 - 1. Power-Operated Sliding Doors: Not more than 30 lbf required to prevent stopped door from closing.

1.5 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 automatic entrances. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For automatic entrances. Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Activation and safety devices.

- 4. Include hardware schedule and indicate hardware types, functions, quantities, and locations.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Product Certificates: For each type of emergency-exit automatic entrance, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for automatic entrances.
- D. Field quality-control reports.
- E. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For automatic entrances, safety devices, and control systems to include in maintenance manuals

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer with company certificate issued by AAADM.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.
- C. Certified Inspector Qualifications: Certified by AAADM.
- D. Source Limitations for Automatic Entrances: Obtain automatic entrances from single source from single manufacturer.
- E. 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.
- F. Power-Operated Door Standard: BHMA A156.10.
- G. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as a required means of egress.

- H. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to automatic entrances including, but not limited to, the following:
 - a. Structural load limitations.
 - b. Construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Coordination with electrical, glazing, and other trades.
 - d. Required testing, inspecting, and certifying procedures.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings to receive automatic entrances by field measurements before fabrication.

1.10 COORDINATION

- A. Templates: Obtain templates for doors, frames, and other work specified to be factory prepared for installing automatic entrances, and distribute to parties involved. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic entrances to comply with indicated requirements.
- B. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.
- C. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Faulty operation of operators, controls, and hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Two years from date of Substantial Completion.

- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. 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. Warranty Period: 10 years from date of Substantial Completion.

1.12 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of automatic entrance Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper automatic entrance operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
 - 1. Engage a certified inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
 - 2. Perform maintenance, including emergency callback service, during normal working hours.
 - 3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - 2. Sheet and Plate: ASTM B 209 (ASTM B 209M).
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
- C. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.
- D. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- E. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness, in entrance manufacturer's standard thickness.
- F. Glazing: As specified in Division 8 Section "Glazing."
- G. Sealants and Joint Fillers: As specified in Division 7 Section "Joint Sealants."
- H. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos; formulated for 30-mil (0.76-mm) thickness per coat.
- I. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.2 SLIDING AUTOMATIC ENTRANCES

- A. General: Provide manufacturer's standard automatic entrances including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, miscellaneous framing and supports and accessories required for a complete installation.
- B. Sliding Automatic Entrance:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Besam Automated Entrance Systems, Inc.; an ASSA ABLOY Group company.
 - b. DORMA Automatics; Div. of DORMA Group North America.
 - c. Horton Automatics; Div. of Overhead Door Corporation.
 - d. Record-USA.
 - e. Stanley Access Technologies; Div. of The Stanley Works.
 2. Configuration: Biparting-sliding doors, with two sliding leaves and sidelites on each side.
 - a. Traffic Pattern: Two way.
 - b. Emergency Breakaway Capability: Sliding leaves and sidelites and as indicated on Drawings.
 - c. Mounting: Between jambs.

3. Operator Features:
 - a. Power opening and closing.
 - b. Drive System: Chain or belt.
 - c. Adjustable opening and closing speeds.
 - d. Adjustable hold-open time between 0 and 30 seconds.
 - e. Obstruction recycle.
 - f. On-off/hold-open switch to control electric power to operator, key operated.
4. Sliding Door Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.
 - a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.
5. Sliding Door Threshold: Manufacturer's standard threshold members and bottom-guide track system, with stainless-steel, ball-bearing-center roller wheels.
 - a. Configuration: Recessed threshold across door opening and recessed guide track system at sidelites.
6. Combination Activation and Safety Device: Combination motion/presence sensor mounted on each side of door header to detect pedestrians in activating zone and to open door.
7. Safety Devices: Two photoelectric beams mounted in sidelite jambs to detect pedestrians in presence zone and to prevent door from closing.
8. Sidelite Safety Device: Presence sensor, mounted above each sidelite on side of door opening through which doors travel, to detect obstructions and to prevent door from opening.
9. Finish: Finish framing, door(s), sidelite(s), and header with Class I, clear anodic finish.

2.3 ENTRANCE COMPONENTS

- A. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.
 1. Nominal Size: 1-3/4 by 4-1/2 inches.
- B. Stile and Rail Doors: Manufacturer's standard 1-3/4-inch-thick, glazed doors with minimum 0.125-inch-thick, extruded-aluminum tubular stile and rail members and clad in stainless-steel sheet. Mechanically fasten corners with reinforcing brackets that are welded, or incorporate concealed tie-rods that span full length of top and bottom rails.

1. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and manufacturer's standard preformed gaskets.
 2. Stile Design: Narrow stile, 2-inch nominal width or as indicated on Drawings.
 3. Rail Design: 6-inch nominal height or as indicated on Drawings.
- C. Sidelite(s): Manufacturer's standard 1-3/4-inch-deep sidelite(s) with minimum 0.125-inch-thick, extruded-aluminum tubular stile and rail members and clad in stainless-steel sheet, matching door design and finish.
1. Glazing Stops and Gaskets: Same materials and design as for doors.
- D. Headers: Fabricated from minimum 0.125-inch-thick, extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
1. Mounting: Concealed, with one side of header flush with framing.
 2. Capacity: Capable of supporting doors up to 175 lb per leaf over spans up to 14 feet without intermediate supports.
 - a. Provide sag rods for spans exceeding 14 feet.
- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- F. Signage: Affixed to both sides of each door as required by BHMA A156.10 for type of door and its operation.
1. Application Process: Door manufacturer's standard process.
 2. Provide sign materials with instructions for field application after glazing is installed.

2.4 DOOR OPERATORS AND ACTIVATION AND SAFETY DEVICES

- A. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
1. Door Operator Performance: Provide door operators that will open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
 2. Electromechanical Operators: Concealed, self-contained, overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state

microprocessor controller; UL 325; and with manual operation with power off.

- B. Combination Motion/Presence Sensors: Self-contained units; consisting of both motion and presence sensors in a single metal or plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10.
 - 1. Motion Sensor: K-band-frequency, microwave-scanner units; with relay hold time of not less than 2 to 10 seconds.
 - 2. Presence Sensor: Infrared-scanner units; with relay hold time of not less than 2 to 10 seconds. Sensors shall remain active at all times.
- C. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.
- D. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.
- E. Opening-Width Control: Two-position switch that in the normal position allows sliding doors to travel to full opening width and in the alternate position reduces opening to a selected partial opening width.

2.5 HARDWARE

- A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish.
- B. Breakaway Device for Power-Operated Doors: Provide breakaway device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be 50 lbf (222 N) according to BHMA A156.10. Interrupt powered operation of door operator while in breakaway mode.
- C. Pivots:
 - 1. Center-Pivot Sets: BHMA A156.4, Grade 1, with exposed parts of cast-aluminum alloy.
- D. Deadlocks: Manufacturer's standard deadbolt operated by exterior cylinder and interior thumb turn, with minimum 1-inch- (25-mm-) long throw bolt; BHMA A156.5, Grade 1.
 - 1. Cylinders: BHMA A156.5, Grade 1, six-pin mortise type.
 - a. Keying: Integrate into building master key system.
 - 2. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.

3. Two-Point Locking for Sliding Doors: Mechanism in stile of active door leaf that automatically extends second lockbolt into overhead carrier assembly and threshold.
 4. Include locking devices for sidelites, to prevent manual break out.
- E. Weather Stripping: Manufacturer's standard replaceable components.
1. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.6 FABRICATION

- A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.
1. Form aluminum shapes before finishing.
 2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
 3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws finished to match framing.
 - a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - b. Reinforce members as required to receive fastener threads.
 4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.
1. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
 2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 3. Form profiles that are sharp, straight, and free of defects or deformations.
 4. Provide components with concealed fasteners and anchor and connection devices.
 5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.

- 6. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within system to the exterior.
 - 7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
 - 8. Allow for thermal expansion of exterior units.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
 - D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
 - E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."
 - F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.
 - 1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors and breakaway sidelites.
 - G. Activation and Safety Devices:
 - 1. General: Factory install devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
 - 2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:
 - a. Top Beam: 48 inches (1219 mm).
 - b. Bottom Beam: 24 inches (610 mm).

2.7 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 shipping.
- C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
 - 1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 - 2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
 - 3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
 - 4. Level recesses for recessed thresholds using nonshrink grout.
- C. Door Operators: Connect door operators to electrical power distribution system as indicated in Division 16 Sections.
- D. Access-Control Devices: Connect access-control devices to access-control system as specified in Division 16 Sections.

- E. Activation and Safety Devices: Install and adjust devices to provide detection field and functions indicated.
- F. Glazing: Install glazing as specified in Division 08 Section "Interior Glazing."
- G. Sealants: Comply with requirements specified in Division 07 Section "Joint Sealants" to provide weathertight installation.
 - 1. Set framing members and flashings in full sealant bed.
 - 2. Seal perimeter of framing members with sealant.
- H. Signage: Apply signage on both sides of each door and breakaway sidelight as required by referenced door standards.
- I. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 FIELD QUALITY CONTROL

- A. Inspection: Engage Installer's certified inspector to test and inspect automatic entrances and prepare test and inspection reports.
 - 1. Certified inspector shall test and inspect each automatic entrance to determine compliance of installed systems with applicable BHMA standards.
 - 2. Inspection Report: Certified inspector shall submit report in writing to Architect and Contractor within 24 hours after inspection.
- B. Work will be considered defective if it does not pass tests and inspections.

3.4 ADJUSTING

- A. Adjust door operators, controls, and hardware for smooth and safe operation and for weathertight closure; comply with requirements in BHMA A156.10.
- B. Lubricate operating hardware and other moving parts as recommended by manufacturer.
- C. Readjust door operators and controls after repeated operation of completed installation equivalent to 3 days' use by normal traffic (100 to 300 cycles). Lubricate hardware, operating equipment, and other moving parts.
- D. 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 CLEANING AND PROTECTION

- A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
 - 1. Comply with requirements in Division 08 Section "Interior Glazing" for cleaning and maintaining glass.

3.6 DEMONSTRATION

- A. Engage a certified inspector to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION 084229.23

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide all Finish Hardware as shown on the Drawing or as specified herein unless specified excluded and called for in other Sections.
- B. All items of Finish Hardware shall be guaranteed for one year, except closers shall be guaranteed for five years.
- C. Conform to building code and life safety code requirement If more restrictive than those specified herein, including UBC 7-2(1997) for positive pressure. Notify Architect of differences prior to starting work. Conform to Underwriters Laboratories (U.L.) requirements for fire rated openings, including UL10-C for positive pressure.

1.2 REFERENCES

- A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
- B. NFPA 80 - Fire Doors and Windows.
- C. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
- D. NFPA 252 - Fire Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate locations and mounting heights of each type of hardware, electrical characteristics and connection requirements.
- C. Submit manufacturer's parts lists, and templates.
- D. Samples: Submit sample illustrating style, color, and finish of hardware items.
- E. Samples: Will be incorporated into the Work.
- F. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.

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1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 70 00.
- B. Record actual locations of installed cylinders and their master key code.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01 70 00.
- B. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with the following requirements:
 - 1. ANSI A117.1.
 - 2. NFPA 101.
 - 3. NFPA 80.
 - 4. NFPA 252.

1.7 QUALIFICATIONS

- A. Hardware Supplier: Company specializing in supplying commercial door hardware with documented experience.
- B. Hardware Supplier Personnel: Employ a qualified person to assist in the work of this section.

1.8 REGULATORY REQUIREMENTS

- A. Conform to applicable code for requirements applicable to fire rated doors and frames.
- B. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.9 PRE-INSTALLATION CONFERENCE

- A. Convene one week prior to commencing work of this section, under provisions of Section 01 30 00.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.

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- B. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.
- C. Deliver keys to Owner by security shipment direct from hardware supplier.

1.11 COORDINATION

- A. Coordinate work under provisions of Section 01 30 00.
- B. Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware.

1.12 WARRANTY

- A. Provide one year warranty under provisions of Section 01 70 00.

1.13 MAINTENANCE MATERIALS

- A. Provide maintenance materials under provisions of 01 70 00.
- B. Provide special wrenches and tools applicable to each different or special hardware component.
- C. Provide maintenance tools and accessories supplied by hardware component manufacturer.

1.14 EXTRA MATERIALS

- A. Furnish under provisions of Section 01 70 00.
- B. Provide ten extra key lock cylinders for each master keyed group.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The following are acceptable manufacturers for the item of hardware indicated. The first manufacturer listed is the manufacturer used in the hardware schedule at the end of this section unless indicated otherwise.
 - 1. Hinges: Hager, Stanley Lawrance, & McKinney.
 - 2. Push/Pulls and Armor Plate: Hiawatha, Hager, Rockwood & Tremco.
 - 3. Cylinder: Best 7-pin with interchangeable core. (No substitution).
 - 4. Mortise Lockset/Latchset: Corbin-Russwin, Schlage, Sargent, and Yale.
 - 5. Exit Devices: Von Duprin (No substitution).
 - 6. Closers: LCN (No substitution).
 - 7. Overhead Holders: Glynn Johnson.

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8. Manual and Automatic Flush Bolts & Coordinators: Ives, Glynn Johnson & Trimco
9. Gasketing: Reese, Pemko, Hager, & Stanley.
10. Stops: Ives, Glynn Johnson & Hager.
11. Sweeps: Reese & Pemko.
12. Thresholds: Reese & Pemko.
13. Weather-Stripping: Reese & Pemko.
14. Magnetic Holders: Rixon & Von Duprin
15. Substitutions: Under provisions of Section 01 60 00.

2.2 KEYING

- A. All lock cylinders shall be Masterkeyed or Grand Masterkeyed as directed by the Owner and Architect.
- B. Hardware supplier shall prepare keying schedule and meet with owner and Architect to review and obtain approval. Supply six (6) Master keys per set.
- C. Keying must be done by lock manufacturer or supplier, Manufacturer or supplier is to keep complete and proper records and identification of master keys and their serial numbers.
- D. Furnish two (2) change keys per lock.
- E. All keys shall be properly marked immediately upon receipt and turned over to the Owner at completion of project

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: 24 volts, single phase, 60 Hz.

2.4 KEY CABINET

- A. Cabinet Construction: Sheet steel construction, piano hinged door with lock master keyed to building system.
- B. Cabinet Size: Size for project keys plus 10 percent growth.
- C. Horizontal metal strips for key hook labeling with clear plastic strip cover over labels.
- D. Finish: Baked enamel finish, color as selected.

2.5 FINISHES

- A. Finishes: As follows:
 1. Butts, Exterior: US32D
 2. Interior: US26D

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3. Locksets: US26D/US32D
4. Door Closers: ALUM
5. Exit Devices: US26D/US32D
6. Push Bars, Push Plates, Pulls: US32D
7. Kickplates: US32D
8. Stops and Holders: US26D
9. Misc., Hardware: US26D

2.6 BUTTS

- A. The following is a table of butt types in manufacturer's catalogue numbers that are considered acceptable. No substitutions will be allowed:

| | <u>Hager</u> | <u>Stanley</u> | <u>McKinney</u> | <u>Lawrence</u> |
|--------|--------------|----------------|-----------------|-----------------|
| Type 1 | BB1199 | BB199 | T4B3386 | BB5151A |
| Type 2 | BB1191 | BB191 | TB2314 | BB4101A |
| Type 3 | BB1168 | B168 | T4B3786 | BB5151 |
| Type 4 | BB1279 | BB179 | TB2714 | BB4101 |
| Type 5 | 1279 | 179 | 2714 | 4181 |

- B. Butt types shall be furnished as follows, except as otherwise noted:
1. Exterior Outswing Doors: Type 1 x NRP
 2. Exterior Inswing Doors: Type 3
 3. Interior Doors with Closers: Type 4
 4. Interior Doors without Closers: Type 5
- C. Butt quantities and sizes shall be as follows, except as otherwise noted. All butts shall be 4-1/2 x 4-1/2 for 1-3/4" doors and 3-1/2x3-1/2 for 1-3/8" doors.
1. Two (2) butts for doors 60" in height and under.
 2. Three (3) butts for doors 61" thru 90" in height.
 3. Four (4) butts for doors 91" thru 120" in height or over 3'-8" wide.
 4. Four (4) butts for dutch doors.
- D. Provide proper width of butts to clear trim and allow full 180 degree swing.

2.7 LOCKSETS AND LATCHSETS

- A. Unless otherwise indicated in hardware groups, all locks, latches, trim, and deadlocks shall be the products of one manufacturer.
- B. Provide wrought boxes and strikes with proper length to protect trim, provide open back strikes where required. Lock functions shall be as listed in hardware groups.

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2.8 EXIT DEVICES

- A. All exit devices shall be UL listed for safety requirements as well as listed for labeled doors.

2.9 DOOR CLOSERS

- A. All closers shall be of rack and pinion construction with separate adjusting valves for latching speed, closing speed and backcheck. All closers to be surface applied and have non-ferrous covers.
- B. All closers to be mounted on room side wherever possible, where wall conditions permit, all doors shall swing 180 degrees.
- C. It shall be the hardware suppliers responsibility to furnish door closers sized to comply with manufacturer's recommendations for door sizes. Furnish thru bolts for all label wood doors.

2.10 DOOR STOPS AND HOLDERS

- A. Unless otherwise indicated, all door stops shall be equal to Glynn Johnson GJWB50W OR GJWB60W.
- B. Where wall bumpers are not applicable, provide overhead door stays equal to Glynn Johnson GJ450 series, unless otherwise specified.
- C. Provide overhead holders and shock absorber equal to Glynn Johnson GJ900M for all exterior doors call for, unless otherwise specified.

2.11 FLUSH BOLTS

- A. Unless otherwise indicated, Inactive doors of pairs shall have two flush bolts, equal to H. B. Ives FB358, FB458UL. The bottom bolt shall be provided with a dustproof stike, equal to H. B. Ives _DP2.
- B. Where indicated, furnish constant latching flush bolts H. B. Ives FB61P on Wood Doors H. B. Ives FB51P on Hollow Metal doors.
- C. Where indicated, furnish Coordinators equal to H. B. Ives COR_complete with proper filler bar H. B. Ives FL, also furnish mounting brackets for any stop mounted hardware equal to H. B. Ives MB1 OR MB2, Provide carry open bars where applicable equal to H. B. Ives CB1.

2.12 WEATHERSTRIPPING, THRESHOLDS, SWEEPS AND SMOKESTRIPPING

- A. Unless otherwise indicated, thresholds shall be equal to Reese S204A Weatherstripping shall be equal to Reese 769C apply to head and jambs where indicated in hardware groups.

- B. Sweeps shall be equal to Reese 323C, apply to door bottoms where indicated in hardware.
- C. Smokestripping shall be equal to Reese F798B, apply to head and jambs where indicated in hardware groups.

2.13 SCHEDULE

- A. Refer to schedule at the end of this section for hardware to be provide for each door listed on Door Schedule.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 01 30 00.
- B. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.
- C. Verify that electric power is available to power operated devices and of the correct characteristics.

3.2 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions.
- B. Use templates provided by hardware item manufacturer.
- C. Carefully install hardware, using skilled finish carpenters.
- D. Fit before painters finish is applied, remove and reinstall after finish is complete.
- E. Install hardware so that all operating parts operate smoothly, close tightly, and do not rattle.
- F. Carefully install hardware as listed in the installation instructions furnished with each finish hardware item, adhere to manufacturer's instructions for mounting.
- G. Set metal thresholds in full bed of specified caulking compound, forming tight seal between threshold and surface to which set. Securely anchor thresholds using countersunk non-ferrous screws to match color of threshold.
- H. Provide all anchorage, fasteners, etc. as required for the complete installation of all hardware.

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- I. Furnish thru-bolts for all butts (surface type only), closers, exit devices, push bars, and other hardware subject to severe usage or as required by UL
- J. Mounting heights for hardware from finished floor to center line of hardware item:
 - 1. Locksets: ANSI 117.1.
 - 2. Push/Pulls: ANSI 117.1.
 - 3. Dead Locks: ANSI 117.1.
 - 4. Exit Devices: ANSI 117.1.

3.3 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 40 00.
- B. Factory representative to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.4 ADJUSTING

- A. Adjust work under provisions of Section 01 70 00.
- B. Adjust hardware for smooth operation.

3.5 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 50 00.
- B. Do not permit adjacent work to damage hardware or finish.

3.6 SCHEDULE

- A. The following schedule of hardware will be considered a guide only. It will be the hardware supplier's responsibility to advise the Architect before bidding if a conflict exists.
- B. Refer to floor plans and/or door schedule for hardware group required at each opening. Ignore hardware groups not used on floor plans or door schedule. If conflict exists between The hardware preamble and schedule of hardware groups, the hardware listed in hardware group shall be furnished.

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C. GROUP 1

1. DOORS B04, 102A, 102B, 202, 302A
 - a. 4 EA. OFFSET PIVOT HINGES BY ALUMINUM DOOR SUPPLIER
 - b. 2 EA. NORTON 1601 CLOSER BY ALUMINIM DOOR SUPPLIER
 - c. 2 EA. DOR-O-MATIC/FALCON 1690 EXIT DEVICE BY ALUMINUM DOOR SUPPLIER
 - d. 2 EA. EXIT DEVICE PULLS BY ALUMINUM DOOR SUPPLIER
 - e. 1 EA. 4110-61 BLADE STOP SPACER
 - f. 1 EA. 4110-30 CUSH SHOE SUPPORT
 - g. 1 EA. S204A THRESHOLD
 - h. 1 SE. WEATHERSTRIPPING BY ALUMINUM DOOR SUPPLIER
 - i. 2 EA. SWEEP BY ALUMINUM DOOR SUPPLIER

D. GROUP 2

1. DOOR 302B
 - a. 4 EA. OFFSET PIVOT HINGES BY ALUMINUM DOOR SUPPLIER
 - b. 2 EA. SET PULL / PUSH HANDLES BY ALUMINUM DOOR SUPPLIER
 - c. 2 EA. NORTON 1601 CLOSER BY ALUMINUM DOOR SUPPLIER
 - d. 1 EA. PR. FLUSH BOLTS BY ALUMINUM DOOR SUPPLIER
 - e. 1 EA. KEYED CYLINDER BY ALUMINUM DOOR SUPPLIER
 - f. 1 EA. S204A THRESHOLD
 - g. 1 SE. WEATHERSTRIPPING BY ALUMINUM DOOR SUPPLIER

E. GROUP 3

1. DOOR 302C
 - a. 4 EA. OFFSET PIVOT HINGES BY ALUMINUM DOOR SUPPLIER
 - b. 2 EA. SET PULL / PUSH HANDLES BY ALUMINUM DOOR SUPPLIER
 - c. 2 EA. NORTON 1601 CLOSER BY ALUMINUM DOOR SUPPLIER
 - d. 1 EA. PR. FLUSH BOLTS BY ALUMINUM DOOR SUPPLIER
 - e. 1 EA. S204A THRESHOLD
 - f. 1 SE. WEATHERSTRIPPING BY ALUMINUM DOOR SUPPLIER

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F. GROUP 4

1. DOORS B07, 101A, 103, 104A, 107
 - a. 3 EA. BB1199 4.5 X 4.5 NRP US32D HINGES
 - b. 1 EA. L9080 x 06A x US26D EXIT PASSAGE (LESS OUTSIDE LEVER)
 - c. 1 EA. 4111 H CUSH CLOSER
 - d. 1 EA. S204A THRESHOLD
 - e. 1 EA. 769C X 4080 WEATHERSTRIPPING
 - f. 1 EA. 323C X 48" SWEEP

G. GROUP 5

1. DOORS B01, 101B, 201, 301, 204, 304
 - a. 3 EA. BB1279 4.5 x 4.5 US26D
 - b. 1 EA. L9010 x 06A x US26D PASSAGE
 - c. 1 EA. 4111 x ALUM CLOSER
 - d. 1 SE. F798B SMOKE GASKET
 - e. 1 EA. 232W32D WALL STOP
 - f. 1 EA. KICKPLATE

H. GROUP 6

1. DOOR 104B
 - a. 3 EA. BB1279 4.5 x 4.5 US26D
 - b. 1 EA. L9080PD x 06A x US26D STOREROOM LOCKSET
 - c. 1 EA. 4011 x ALUM CLOSER
 - d. 1 EA. 769C X 4080 WEATHERSTRIPPING
 - e. 1 EA. 232W32D WALL STOP
 - f. 1 EA. 323C X 48" SWEEP

I. GROUP 7

1. DOOR 106
 - a. 3 EA. BB1279 4.5 x 4.5 US26D
 - b. 1 EA. L9010 x 06A x US26D PASSAGE
 - c. 1 EA. 4011 x ALUM CLOSER
 - d. 1 SE. F798B SMOKE GASKET
 - e. 1 EA. 232W32D WALL STOP

J. GROUP 8

1. DOOR 105
 - a. 6 EA. BB1279 4.5 x 4.5 US26D
 - b. 1 EA. L9080PD x 06A x US26D STOREROOM LOCKSET
 - c. 1 PR. FB358 MANUAL FLUSHBOLTS x US26D
 - d. 1 EA. DP2 x US26D DUST PROOF STRIKE
 - e. 2 EA. 232W32D WALL STOP

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- K. GROUP 9
 - 1. DOORS B02, B03, B05
 - a. 3 EA. BB1279 4.5 x 4.5 US26D
 - b. 1 EA. L9080PD x 06A x US26D STOREROOM LOCK
 - c. 1 EA. 4011 x ALUM CLOSER
 - d. 1 EA. 232W32D WALL STOP
 - e. 1 EA. KICKPLATE

END OF SECTION

SECTION 08 81 00

GLASS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Glass and glazing.

1.2 REFERENCES

- A. FGMA -Glazing Manual.
- B. ASTM C 1036: Standard Specification for Flat Glass.
- C. ASTM C 1048: Standard Specifications for Heat-Treated Flat Glass - Kind HS, Kind HT Coated and Uncoated Glass

1.3 QUALITY ASSURANCE

- A. Conform to Flat Glass Marketing Association (FGMA) Glazing Manual for glazing installation methods.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 01 33 00.
- B. Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Provide data on glazing sealant. Identify colors available.
- D. Submit sealed glass unit manufacturer's certificate under provisions of Section 01 40 00 indicating units meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to site under provisions of Section 01 60 00.
- B. Store and protect products under provisions of Section 01 60 00.

1.6 WARRANTY

- A. Provide ten year manufacturer's warranty under provisions of Section 01 70 00.

PART 2 PRODUCTS

2.1 ACCEPTABLE GLASS MANUFACTURERS

- A. Viracon, 800 Park Drive, Owatonna, MN 55060.
- B. Other acceptable manufacturers offering equivalent products:
 - 1. Old Castle Glass
- C. Substitutions: Under provisions of Section 01 60 00.

2.2 MATERIALS

- A. Type GL-1 – Tempered Insulated Glass Unit:
 - 1. 1 inch thick unit.
 - 2. Outer pane of 1/4 inch Low E Clear Heat Strengthened Glass (Type FG-EHC): Clear heat strengthened glass Type FG-CH, with low emissivity coating on Number 2 surface.
 - 3. Inner pane of 1/4 inch Clear Heat Strengthened Glass (Type FG-CH): ASTM C1048, Kind HS, heat strengthened, Condition A uncoated, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select.
 - 4. Manufactured by Viracon.
- B. Type GL-2 - Insulated Glass Unit:
 - 1. 1 inch thick unit.
 - 2. Outer pane of 1/4 inch Low E Clear Float Glass (Type FG-EC): Clear float glass Type FG-CF, with low emissivity coating on inner surface.
 - 3. Inner pane of 1/4 inch Clear Float Glass (Type FG-CF): ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select.
 - 4. Manufactured by Viracon.
- C. Type GL-3 – Insulated Spandrel Glass:
 - 1. 1 inch thick unit.
 - 2. Outer pane of 1/4 inch Spandrel Coated Glass (Type FG-SC): ASTM C1048 Kind Condition C other coated glass; coat back (Number 2) surface.
 - 3. Inner pane of 1/4 inch Clear Float Glass (Type FG-CF): ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select.
 - 4. Manufactured by Viracon.
- D. Type GL-4 - Plate Glass:
 - 1. 1/4 inch clear glass meeting ASTM C 1036 Glazing Select Quality; as manufactured by Viracon.

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- E. Type GL-5 - Tempered Glass:
 - 1. 1/4 inch clear tempered glass meeting ASTM C 1048 Kind FT Type I Class 1; as manufactured by Viracon.
- 2.3 ACCEPTABLE GLAZING ACCESSORIES MANUFACTURERS
 - A. Tremco.
 - B. Substitutions: Under provisions of Section 01 60 00.
- 2.4 GLAZING ACCESSORIES
 - A. Setting Blocks: Neoprene; 70-90 Shore A durometer hardness; 4 inch long x 3/8 inch wide x 1/4 inch high.
 - B. Spacer Shims: Neoprene; 50 Shore A durometer hardness; 3 inch long x 1/4 inch wide x 1/4 inch thick; self adhesive one face.
 - C. Glazing Tape: Pre-shimmed Tremco 440 tape.
 - D. Sealant: Tremco Dymeric.
 - E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

- 3.1 INSPECTION
 - A. Verify surfaces of glazing channels or recesses are clean, free of obstructions, and ready for work of this Section.
 - B. Beginning of installation means acceptance of substrate.
- 3.2 PREPARATION
 - A. Clean contact surfaces with solvent and wipe dry.
 - B. Seal porous glazing channels or recesses.
 - C. Prime surfaces scheduled to receive sealant.
- 3.3 EXTERIOR COMBINATION METHOD (TAPE AND SEALANT)
 - A. Cut glazing tape to length and set against permanent stops, 3/16 inch below sightline. Seal corners by butting tape and dabbing with sealant.
 - B. Apply heel bed of sealant along exterior void ensuring full contact with pane.

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- C. Place setting blocks at 1/4 points.
- D. Rest glass on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane.
- E. Place glazing tape on glass with tape 1/4 inch below sightline. Install removable stops, spacer strips inserted between glass, and applied stops at 24 inch intervals, 1/4 inch below sightline.
- F. Apply cap bead of sealant along exterior void, to uniform line, flush with sightline. Tool or wipe sealant surface with solvent for smooth appearance.

3.4 INTERIOR DRY METHOD (TAPE AND TAPE)

- A. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sightline.
- B. Place setting blocks at 1/4 points.
- C. Rest glass on setting blocks and push against tape for full contact at perimeter of pane.
- D. Place glazing tape on free perimeter of pane in same manner described above.
- E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- F. Knife trim protruding tape.

3.5 CLEANING

- A. After installation, mark pane with an "X" by using plastic tape or removable paste.
- B. Remove glazing materials from finish surfaces.
- C. Remove labels after work is completed.

END OF SECTION

SECTION 08 91 19

FIXED METAL WALL LOUVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fixed louvers and frames.
- B. Insect screening.

1.2 REFERENCES

- A. AMCA 500 (Air Movement Control Association) - Test Method for Louvers, Dampers, and Shutters.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- C. Samples: Submit samples illustrating finish and color of exterior surfaces.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA Certification for louvers.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.6 FIELD MEASUREMENTS

- A. Verify that field measurements are as instructed by the manufacturer.

1.7 COORDINATION

- A. Coordinate work under provisions of Section 01 30 00.
- B. Coordinate the Work with installation of metal siding.

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1.8 WARRANTY

- A. Provide twenty year warranty under provisions of Section 01 70 00.
- B. Warranty: Include coverage for degradation of finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cesco Products, P.O. Box 606, 7435 Industrial Rd., Florence, KY 41042; Phone: 859-538-3450, Fax: 859-647-7810, www.cescoproducts.com.
- B. Substitutions: Under provisions of Section 01 60 00.

2.2 MANUFACTURED UNITS

- A. Fixed Wall Louver: Model #X4D3, with 14x18 .009" galvanized steel mesh insect screen; finish shall be baked enamel; color as selected by the Architect from the manufacturer's standard finishes.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Stainless steel type.
- B. Flashings: Of same material as louver frame.
- C. Sealants: Type specified in Section 07 92 00.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 01 30 00.
- B. Verify that prepared openings are ready to receive work and opening dimensions are as instructed by the louver manufacturer.

3.2 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

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- D. Secure louvers in opening framing with concealed fasteners.
- E. Install insect screen and frame to interior of louver.
- F. Install perimeter sealant and backing rod in accordance with Section 07 92 00.

3.3 CLEANING

- A. Clean work under provisions of 01 70 00.
- B. Clean surfaces and components.

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes non-structural steel framing members for the following applications:
 - 1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
 - 2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

1.2 SUBMITTALS

- A. Submit product data under provisions of Section 01 33 00.
- B. Product Data: For each type of product indicated.
- C. Submit product data describing standard framing member materials and finish, product criteria, load charts, and limitations.
- D. Submit manufacturer's installation instructions under provisions of Section 01 30 00.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-structural steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency. Products used in the assembly shall carry a classification label from a testing laboratory acceptable to authority having jurisdiction.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PRODUCTS

1.4 NON-STRUCTURAL STEEL FRAMING, GENERAL

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: ASTM C 645/C 645M, G40 , or equivalent corrosion resistance.

1.5 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch diameter wire, or double strand of 0.0475-inch diameter wire.
- B. Hanger Attachments to Concrete:
 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Post-installed, chemical anchor.
 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- D. Flat Hangers: Steel sheet, in size indicated on Drawings.
- E. Carrying Channels: ASTM C754, shall be cold-formed from steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch wide flanges.
 1. Depth: As indicated on Drawings.
- F. Furring Channels (Furring Members):
 1. Resilient Furring Channels: 1/2-inch deep members designed to reduce sound transmission.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Dietrich Metal Framing; RC Deluxe Resilient Channel RCSD.
 - b. Configuration: Asymmetrical.
- G. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Fire Front 670-C Drywall Furring System.

- c. USG Corporation; Drywall Suspension System.

1.6 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Dietrich Metal Framing UltraSTEEL® 20 gauge-equivalent.
 - 2. Minimum Base-Metal Thickness: 0.0296 inch.
 - 3. Members that can show independently verified test performance that meets the limiting height values listed in C 754 need not meet the minimum thickness limitation set forth in 4.3 or the minimum section properties set forth in 8.1.
 - 4. Size: As indicated on Drawings.
- B. Flat Strap and Backing Plate: Sheet for blocking and bracing in length and width indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Dietrich Metal Framing; Danback Fire Treated Wood Backing Plate D24F.
- C. Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Dietrich Metal Framing; Spazzer® 9200 Bridging and Spacing Bar
 - 2. Depth: As indicated on Drawings.
 - 3. Clip Angle: Subject to compliance with requirements, provide Dietrich Metal Framing; EasyClip™ U-Series Clip Angle U547.
- D. Carrying Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch wide flanges.
 - 1. Depth: 2 inch.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0296 inch.
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch diameter wire, or double strand of 0.0475-inch diameter wire.
- E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

1.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 2 EXECUTION

2.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

2.2 PREPARATION

- A. Coordination with Sprayed Fire-Resistive Materials:
 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

2.3 INSTALLATION, GENERAL

- A. Installation Standard: comply with ASTM C 754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.

- D. Do not bridge building control and expansion joints with non-structural steel framing members. Frame both sides of joints independently.

2.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - a. Do not attach hangers to steel roof deck.
 - b. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - c. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - d. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main

beam and cross-furring members to each other and butt-cut to fit into wall track.

- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

2.5 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb, unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- D. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

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- E. Z-Furring Members:
 - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches o.c.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gypsum board and joint treatment products.
 - 2. Accessories for the installation and trimming of gypsum board partitions and ceilings.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. A108.11, American National Standard for Interior Installation of Cementitious Backer Units.
- B. American Society for Testing and Materials (ASTM):
 - 1. C 473, Test Methods for Physical Testing of Gypsum Panel Products.
 - 2. C 514, Specification for Nails for the Application of Gypsum Wallboard.
 - 3. C 840, Specification for Application and Finishing of Gypsum Board.
 - 4. C 954, Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.33 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - 5. C 1002, Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases.
 - 6. C 1047, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - 7. C 1396, Specification for Gypsum Board.
 - 8. C 1629, Classification for Abuse-Resistant Non-decorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
 - 9. D 3273, Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - 10. D 5420, Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
 - 11. E 695, Standard Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading.
- C. Gypsum Association (GA):
 - 1. GA-214, Recommended Specifications: Levels of Gypsum Board Finish.

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1.3 SYSTEM DESCRIPTION

- A. Fire-Rated Impact-Resistant Board: Provide boards with indicated impact resistance when tested in accordance with industry proposed standard.
- B. Fire-Rated Abuse-Resistant Board: Provide boards with indicated surface indentation resistance and impact resistance when tested in accordance with the test procedures referenced as modified by National Gypsum Co.

1.4 SUBMITTALS

- A. Product Data: Manufacturers' specifications and installation instructions for each product specified.
- B. Samples: Min. 12 in. by 12 in. coated gypsum board panel for of each type and texture of textured coating.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain gypsum board products, joint treatment products, and textured coatings from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging and Shipping: Have materials shipped in manufacturer's original packages showing manufacturer's name and product brand name.
- B. Storage and Protection: Store materials inside and protected from damage by the elements. Protect ends, edges, and faces of gypsum boards from damage. Protect steel studs and accessories from bending.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Establish and maintain application and finishing environment in accordance with ASTM C 840.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. National Gypsum Company:
 - 1. Gypsum Board:
 - a. Regular Board: Gold Bond Brand Gypsum Wallboard.
 - b. Fire-Rated Board: Gold Bond Brand Fire-Shield Wallboard.
 - c. Fire-Rated Impact/Penetration-Resistant Mold-Resistant Board: Hi-Impact Brand XP Wallboard.
 - d. Sheathing Board: Gold Bond Brand Gypsum Sheathing.

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2. Joint Treatment:
 - a. Tape: ProForm Brand Joint Tape.
 - b. Compound: ProForm Brand All Purpose Joint Compound.
 - c. Compound: ProForm Brand XP Joint Compound
 - d. Compound: ProForm Brand Multi-Use Joint Compound.
 - e. Compound: Proform Brand Taping joint Compound
3. Primer: Proform Brand Surfacers/Primer.

B. Substitutions: Under provisions of Section 01 60 00.

2.2 ACCESSORIES

- A. Corner Bead: Formed galvanized steel angle, min. base steel 0.014 in. thick, and complying with ASTM C 1047.
- B. Casing Bead: Formed galvanized steel trim, min. base steel 0.014 in. thick, and complying with ASTM C 1047, Type as follows:
 1. LC-Bead.
 2. L-Bead.
 3. U-Bead.
- C. Control Joint: Extruded vinyl formed with V shaped slot covered with removable flexible vinyl strip and complying with ASTM C 1047.
- D. Control Joint: Bent zinc sheet formed with V shaped slot, covered with plastic tape, with perforated flanges and Complying with ASTM C 1047.
- E. Screws: ASTM C 954 or ASTM C 1002 or both with heads, threads, points, and finish as recommended by the manufacturer.
- F. Acoustical Sealant: Non-drying, non-hardening, non-skinning, non-staining, non-bleeding, gunnable type as recommended by the manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: In accordance with the following reference standards and manufacturer's recommendations:
 1. Gypsum Sheathing Board: ASTM C 1280.
 2. Gypsum Board and Joint Treatment: ASTM C 840.
 3. Manufacturer's Recommendations:
 - a. "Gypsum Construction Guide," National Gypsum Co.

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- B. Finishing: In accordance with GA-214 as follows:
 - 1. Level 1: Plenums and service corridors.
 - 2. Level 2: Water resistant gypsum backing board scheduled to receive tile.
 - 3. Level 3: Gypsum board scheduled to receive heavy or medium textured coatings and heavy-grade wall coverings.
 - 4. Level 4: Gypsum board scheduled to receive light textured coatings and light-grade wall coverings.
 - 5. Level 5: All other gypsum board.

3.2 PROTECTION

- A. Protect gypsum board installations from damage and deterioration until the date of Substantial Completion.

END OF SECTION

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**SECTION 096543 – LINOLEUM
FLOORING**

PART 1 GENERAL

1.01 THIS SECTION INCLUDES

- A. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

1.02 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 sections) apply to the work of this section.

1.03 RELATED SECTIONS

- A. Other Division 9 sections for floor finishes related to this section but not the work of this section.
- B. Division 3 Concrete; not the work of this section.
- C. Division 6 Wood and Plastics; not the work of this section.
- D. Division 7 Thermal and Moisture Protection; not the work of this section.

1.04 QUALITY ASSURANCE AND REGULATORY REQUIREMENTS

- A. Select an installer who is competent in the installation of the basis of design product "Armstrong MARMORETTE™ Linoleum sheet flooring using heat-welded seams"
- B. If required, provide types of flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives.
- C. If required, provide flooring material to meet the following fire test performance criteria as tested by a recognized independent testing laboratory:
 - a. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I.
 - b. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less.

1.05 SUBMITTALS

- A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.
- B. Submit the manufacturer's standard samples showing the required colors for flooring welding rods, and applicable accessories.
- C. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.

1.06 ENVIRONMENTAL CONDITIONS

- A. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- B. Store materials in a clean, dry, enclosed space off the ground, and protected from the weather and from extremes of heat and cold. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.
- C. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of 100°F (38°C) for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55°F (13°C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances.
- D. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond and moisture tests.

PART 2 PRODUCTS

2.01 Basis Of Design - LINOLEUM SHEET FLOORING MATERIALS

- A. Provide Armstrong MARMORETTE™ with NATURCote™ Linoleum Sheet Flooring manufactured by Armstrong World Industries, Inc, in Stone White, in sizes matching those indicated on contract drawings, having a nominal total thickness of 0.100in. (2.5mm). The wear surface shall consist of a polyurethane-coated homogeneous mixture of linoleum cement (linseed oil, natural tree resins, drying oil catalysts), wood flour, cork flour, color pigments and filler calendered onto a jute fabric backing. Colors and pattern detail shall be dispersed throughout the thickness of the wear layer. Linoleum sheet shall conform to the requirements of ASTM F 2034, Type I, "Standard Specification for Sheet Linoleum Floor Covering."
- B. Provide solid color linoleum weld rod as produced by Armstrong World Industries, Inc., and intended for heat welding of linoleum seams. Color shall be as selected by Architect to contrast with field color of flooring. Color selected from the range currently available from Armstrong World Industries, Inc.

2.02 ADHESIVES

- A. Provide Armstrong S-780 Linoleum Adhesive as recommended by the flooring manufacturer.
- B. Provide Armstrong S-761 Linoleum Seam Adhesive at seams as recommended by the resilient flooring manufacturer.

2.03 ACCESSORIES

- A. For patching, smoothing, and leveling monolithic subfloors to achieve finish floor as indicated on contract drawings, provide Armstrong S-194 Fast-Setting Cement-Based Patch and Underlayment.
- B. For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
- C. Provide transition/reducing strips tapered to meet abutting materials.
- D. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
- E. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage, or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- B. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- C. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- D. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

3.02 PREPARATION

- A. Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Armstrong S-194 Fast-Setting Cement-Based Patch and Underlayment as recommended by the flooring manufacturer.
- B. Remove paint, varnish, oils, release agents, sealers, and waxes. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents.

- C. Perform subfloor moisture testing in accordance with ASTM F 1869, "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride" and Bond Tests as described in publication F-5061, "Armstrong Guaranteed Installation System," to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. MVER shall not exceed 5 lbs./1000 sq. ft./24 hrs. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained.
- D. Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.
- E. Vacuum or broom-clean surfaces to be covered immediately before the application of flooring. Make subfloor free from dust, dirt, grease, and all foreign materials.

3.03 INSTALLATION OF SHEET FLOORING

- A. Install flooring in strict accordance with the latest edition of "Armstrong Guaranteed Installation System", F-5061.
- B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
- C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.
- D. Scribe, cut, and fit or flash cove to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- E. Adhere flooring to the subfloor without cracks, voids, raising and puckering at the seams. Roll with a 100-pound (45.36 kilogram) roller in the field areas. Hand-roll flooring at the perimeter and the seams to assure adhesion. Refer to specific rolling instructions of the flooring manufacturer.
- F. Lay flooring to provide a minimum number of seams. Avoid cross seams, filler pieces, and strips. Match edges for color shading and pattern at the seams in compliance with the manufacturer's recommendations.
- G. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.
- H. Prepare heat-welded seams with special routing tool supplied for this purpose and heat weld with linoleum welding rod in seams. Use methods and sequence of work in conformance with written instructions of the flooring manufacturer. Finish all seams flush and free from voids, recesses, and raised areas.

3.04 INSTALLATION OF ACCESSORIES

- A. Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths as long as practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.

- B. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.
- C. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

3.05 CLEANING AND PROTECTION

- A. Perform initial and ongoing maintenance according to the F-7796 Installation & Maintenance Tip Sheet or the latest edition of "Armstrong Guaranteed Installation System," F-5061.
- B. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings. (See Finishing The Job in "Armstrong Guaranteed Installation System," F-5061.)

END OF SECTION 096543

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**SECTION 096623 – RESINOUS
MATRIX TERRAZZO
FLOORING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Thin-set, epoxy-resin terrazzo flooring and base.
- B. Related Requirements:
 - 1. Division 7 Section 079200 "Joint Sealers" for sealants installed with terrazzo.
 - 2. Division 9 Section 096723 "Resinous Flooring" for decorative resinous flooring systems applied as self-leveling slurries or as troweled or screeded mortars.

1.3 DEFINITIONS

- A. Aggregate: Marble chips or other types of aggregate.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
 - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Review special terrazzo designs and patterns.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include certifications and test reports necessary to show compliance with the Contract Documents
- B. Shop Drawings:
 - 1. Show layout of the following:
 - a. Divider strips.
 - b. Control-joint strips.
 - c. Accessory strips.
 - d. Abrasive strips.

2. Show large scale details of the following:
 - a. Stair treads, risers, and landings.
 - b. Edge configurations.
 - c. Floor electrical devices.
 3. Show terrazzo patterns.
- C. Samples for Verification: :
1. Terrazzo: For each type, provide three (3) 8" x 8" samples showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work.
 2. Accessories: Three (3) 12" long Samples of each exposed strip item required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product, from manufacturer.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terrazzo to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Engage an installer who is a contractor member of NTMA.
 2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
- B. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- C. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with sources or manufacturer's name, material or product brand name, and lot number if any.

- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- B. FloorScore Compliance: Terrazzo floors shall comply with requirements of FloorScore Standard.

2.2 EPOXY-RESIN TERRAZZO

- A. Epoxy-Resin Terrazzo: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and aggregate proportions and mixing.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crossfield Products Corp., Dex-O-Tex Division; Cheminert Terrazzo.
 - b. General Polymers Corporation; Terrazzo 1100.
 - c. Key Resin Company; Key Epoxy Terrazzo.
 - d. Master Terrazzo Technologies LLC; Morricite.
 - e. Quadrant Chemical Corporation; Quadset Epoxy Terrazzo.
 - f. TEC Specialty Construction Brands, Inc.; Tuff-Lite Epoxy Terrazzo.
 - g. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.
 - 2. Thickness: 3/8 inch nominal.

3. Custom Mix Color and Pattern: Match Architect's samples based on formulated design-mixes as prepared by Terrazzo & Marble Supply Companies:
 - a. TER-1 (TM#05-1116) – Igloo: Terroxy WB Urethane, 25% MOP #1, 25% Crystal Glass #1, 25% Arctic White Glass #1, 25% Persian Cream #1.

B. Materials:

1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate-crack preparation and reflective-crack reduction.
 - a. Reinforcement: Fiberglass scrim.
 - b. Joint filler: 2 component 100 percent solids flexible epoxy.
2. Primer: Manufacturer's product recommended for substrate and use indicated.
3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.
 - a. Physical Properties without Aggregates:
 - 1) Bond strength to concrete: 300psi.
 - 2) Hardness: 60 to 85 per ASTM D 2240, Shore D.
 - 3) Minimum Tensile Strength: 3000 psi per ASTM D 638 for a 2-inch specimen made using a "C" die per ASTM D 412.
 - 4) Minimum Compressive Strength: 10,000 psi per ASTM D 695, Specimen B cylinder.
 - 5) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
 - a) Distilled water.
 - b) Mineral water.
 - c) Isopropanol.
 - d) Ethanol.
 - e) 0.025 percent detergent solution.
 - f) 1.0 percent soap solution.
 - g) 10 percent sodium hydroxide.
 - h) 10 percent hydrochloric acid.
 - i) 30 percent sulfuric acid.
 - j) 5 percent acetic acid.
 - b. Physical Properties with Aggregates: For resin blended with Georgia white marble, ground, grouted, and cured per requirements in NTMA's "Terrazzo Specifications and Design Guide"; comply with the following:
 - 1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch per ASTM D 635.
 - 2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F for temperature range of minus 12 to plus 140 deg F per ASTM D 696.
4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
 - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
 - b. 24-Hour Absorption Rate: Less than 0.75 percent.
 - c. Dust Content: Less than 1.0 percent by weight.

- d. Recycled Content of Epoxy-Resin Terrazzo: Postconsumer recycled content plus one-half of preconsumer recycled content not less than twenty percent.
- 5. Divider-strip adhesive: epoxy-resin adhesive recommended by adhesive manufacturer for this use and acceptable to terrazzo manufacturer.
- 6. Finishing Grout: Resin based.

2.3 STRIP MATERIALS

- A. Thin-Set Divider Strips: L-type angle.
 - 1. Material: White-zinc alloy in color(s) selected, as indicated.
 - 2. Top Width: ¼ inch.
 - 3. Strip Height shall be suitable thickness of terrazzo topping, with allowance for grinding.
- B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- C. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
 - 1. Base-bead strips for exposed top edge of terrazzo base.
 - 2. Edge-bead strips for exposed edges of terrazzo.

2.4 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use and acceptable to epoxy-resin manufacturer.
 - 1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Anchoring Devices:
 - 1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and required for secure attachment to substrate.
 - 2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by

sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
2. Acid-Base Properties: With pH factor between 7 and 10.
3. Sealers shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected. Start of Work shall indicate acceptance of the substrate.

3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete Slabs:
 1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
 - c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
- C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 1. Moisture Testing: Perform tests indicated below.
 - a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
- D. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.3 EPOXY-RESIN TERRAZZO INSTALLATION

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."
- C. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.
- D. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
- E. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.
- F. Flexible Reinforcing Membrane:
 - 1. Prepare and prefill substrate cracks with membrane material.
 - 2. Install membrane to produce full substrate coverage in areas to receive terrazzo.
 - 3. Reinforce membrane with fiberglass scrim.
 - 4. Prepare membrane according to manufacturer's written instructions before applying substrate primer.
- G. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.
- H. Strip Materials:
 - 1. Divider and Control-Joint Strips:
 - a. Install divider strips in indicated pattern and at terminal edges of terrazzo. Set accurately, securely, straight, and to required levels. Create tight butt joints where strips adjoin.
 - b. Install control-joint strips back to back directly above concrete-slab control joints and/or in locations indicated.
 - c. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
 - 2. Accessory Strips: Install as required to provide a complete installation.
 - 3. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch higher than terrazzo surface.
- I. Finishing: Grind with 120 or finer grit stones until all grout is removed from surface. Repeat rough grinding, grout coat, and fine grinding if large voids exist after initial fine grinding. Produce surface with a minimum of 70 percent aggregate exposure.

3.4 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent

terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.5 PROTECTION FROM TRAFFIC

- A. Before foot traffic is permitted, cover floors with kraft paper with taped joints. Lay 3/4" plywood walkways over paper in areas used for wheeled traffic. Remove protection after completion of all work or when so authorized by Owner's Representative.

3.6 CLEANING AND PROTECTION

- A. Cleaning:
 - 1. Remove grinding dust from installation and adjacent areas.
 - 2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Sealing:
 - 1. Seal surfaces according to NTMA's written recommendations.
 - 2. Apply sealer according to sealer manufacturer's written instructions.
- C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096623

SECTION 09 91 00

PAINTING

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes surface preparation and field painting of the following:
 - 1. Exposed exterior items and surfaces.
 - 2. Exposed interior items and surfaces.
 - 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections. Revise paragraph below to suit the Project.

1.2 DEFINITIONS

- A. General: Standard coating terms.
 - 1. Flat refers to a sheen finish with a gloss range lower than 5 when measured with a 60-degree meter.
 - 2. Eggshell refers to a low-sheen finish with a gloss range between 5 and 10 when measured with a 60-degree meter.
 - 3. Satin refers to a low-sheen finish with a gloss range between 10 and 20 when measured with a 60-degree meter.
 - 4. Semi-Gloss refers to a medium-sheen finish with a gloss range between 35 and 70 when measured with a 60-degree meter.
 - 5. Full gloss refers to a high-sheen finish with a gloss range higher than 70 when measured with a 60-degree meter.

1.3 SUBMITTALS

- A. Product Data: For each paint system specified. Include block fillers and primers.
 - 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and coating material proposed for use.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing and applying each coating material proposed for use.
 - 3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's).

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- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
 - 1. After color selection, the Architect will furnish color chips for surfaces to be coated.
- C. Product Data Sheets and MSDS for each product to be used as required by the U.S.G.B.C. as proof that each product meets the requirements of either Green Seal's GS-11 or GC-03 documents. This is a requirement in order to receive the possible one point for Credit 4.2 for Low-Emitting Materials in the Indoor Environmental Quality section of the Leadership in Energy and Environmental Design initiative of the U.S. Green Building Council.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator that has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F (7 degrees C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing and application.

1.6 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 degrees F (10 and 32 degrees C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 degrees F (7.2 and 35 degrees C).
- C. Do not apply paint in snow, rain, fog, or mist, or when the relative humidity exceeds 85 percent, or at temperatures less than 5 degrees F (3 degrees C) above the dew point, or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products in the paint schedules.
- B. Manufacturers Names: The following manufacturer is referred to in the paint schedule by use if shortened versions of the name, which is shown below.
 - 1. Pittsburgh® Paints, PPG Industries, Inc.

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, undercoaters, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality "professional" paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

- C. Colors: Provide color matches indicated by reference to manufacturer's color designations.

2.3 CONCRETE MASONRY UNIT BLOCK FILLERS

- A. Concrete Masonry Unit Block Fillers: Factory formulated high-performance latex block fillers
 - 1. Pittsburgh® Paints; 6-7 SPEEDHIDE® Interior/ Exterior Masonry Latex Block Filler (14.00 g/L VOC): Applied at a dry film thickness of not less than 5.1 to 14.7 mils.

2.4 EXTERIOR PRIMERS

- A. Exterior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex primer for exterior application.
 - 1. Pittsburgh® Paints; 4-603 PERMA-CRETE® Interior/Exterior Alkali Resistant Primer (99 g/L VOC): Applied at a dry film thickness of not less than 1.2 mils
- B. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.
 - 1. Pittsburgh® Paints; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC corrosion protection product): Applied at a dry film thickness of not less than 2.0 mils.
- C. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
 - 1. Pittsburgh® Paints; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC corrosion protection product): Applied at a dry film thickness of not less than 2.0 mils.

2.5 INTERIOR PRIMERS

- A. Interior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.
 - 1. Pittsburgh® Paints; 9-900 Pure Performance® Interior Latex Primer Sealer (0 g/L VOC). Applied at a dry film thickness of not less than 1.4 mils.
- B. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
 - 1. Pittsburgh® Paints; 9-900 Pure Performance® Interior Latex Primer (0.00 g/L VOC): Applied at a dry film thickness of not less than 1.4 mils.

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- C. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
 - 1. Pittsburgh® Paints; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC corrosion protection product): Applied at a dry film thickness of not less than 2.0 mils.
- D. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
 - 1. Pittsburgh® Paints; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC corrosion protection product): Applied at a dry film thickness of not less than 2.0 mils.

2.6 EXTERIOR FINISH COATS

- A. Exterior Full-Gloss Acrylic Enamel for Concrete, Masonry, and Wood: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior application.
 - 1. Pittsburgh® Paints; 90-374 Series Pitt-Tech® One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels (192 g/L VOC corrosion protection product): Applied at a dry film thickness of not less than 2.0 mils.
- B. Exterior Full-Gloss Acrylic Enamel for Ferrous and Other Metals: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior application.
 - 1. Pittsburgh® Paints; 90-374 Series Pitt-Tech® One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels (192 g/L VOC corrosion protection product): Applied at a dry film thickness of not less than 2.0 mils.

2.7 INTERIOR FINISH COATS

- A. Interior Satin Acrylic Enamel: Factory-formulated satin acrylic-latex interior enamel.
 - 1. Pittsburgh® Paints; 6-3511 Series SpeedHide® Satin Acrylic Latex Enamel (46 g/L VOC); Applied at a dry film thickness of not less than 0.9 mil.
- B. Interior Full-Gloss Acrylic Enamel: Factory-formulated full-gloss acrylic-latex interior enamel.
 - 1. Pittsburgh® Paints; 6-8534 SpeedHide® Interior Latex 100 Percent Acrylic Gloss Enamels (90 g/L VOC): Applied at a dry film thickness of not less than 1.2 mils.
- C. Interior Gloss Water Borne Acrylic Epoxy:
 - 1. Pittsburgh® Paints; Pitt-Glaze WB Water Borne Acrylic Epoxy 16-551 Series (16-551/16-598, 148 g/L VOC): Applied at a dry film thickness of not less than 2.0 mils.

2.8 COLOR SCHEDULE

- A. PT-1: CMU and drywall partitions, soffits.
 - 1. Color: To match Pittsburgh Paints #515-4 “Moth Gray”
 - 2. Sheen: Satin.
- B. PT-2: Stair handrails.
 - 1. Color: To match Glidden Professional/ICI, Series #00NN 16/000, Order #A2008, “Grey Tabby”
 - 2. Sheen: Gloss.
- C. PT-3: Skywalk exposed ceiling elements.
 - 1. Color: To match Pittsburgh Paints #515-1 “China White”
 - 2. Sheen: Satin (dry fog)
- D. PT-4: Skywalk interior structure.
 - 1. Color: To match Pittsburgh Paints #515-1 “China White”
 - 2. Sheen: Satin.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that site environmental conditions are appropriate for application of coatings specified
- B. Immediately prior to coating application, ensure that surfaces to receive coatings are dry.
- C. Ensure that moisture-retaining substrates to receive coatings have moisture content within tolerances allowed by coating manufacturer, using moisture measurement techniques recommended by coating manufacturer.
- D. Immediately prior to coating application, examine surfaces to receive coatings for surface imperfections and for contaminants which could impair performance or appearance of coatings, including but not limited to, loose primer, rust, scale, oil grease, mildew, algae, or fungus, stains or marks, cracks, indentations, or abrasions.
- E. Correct the above conditions and any other conditions which could impair performance or appearance of coatings in accordance with specified surface preparation procedures before proceeding with coating application.

3.2 PREPARATION

- A. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.
- B. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; seal with shellac or other coating acceptable to paint manufacturer stains and marks that might bleed through paint finishes which cannot be completely removed.
- C. Remove or protect hardware, electrical plates, mechanical grilles and louvers, lighting fixture trim, and other items not indicated to receive coatings which are adjacent to surfaces to receive coatings.
- D. Remove mildew from impervious surfaces by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow substrate to thoroughly dry.
- E. For specific substrate preparation, see individual specifications.

3.3 APPLICATION

- A. Apply paint products in accordance with manufacturer's printed instructions. Do not apply coatings to surfaces that are not dry.
- B. Apply each coat to uniform thickness and finish in accordance with manufacturer's instructions, with each coat slightly darker than preceding coat. Allow each coat to dry thoroughly before applying next coat.
- C. Remove dust and other foreign materials from substrate immediately prior to applying each coat.

3.4 EXTERIOR PAINT SCHEDULE

- A. Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry): Provide the following finish systems over exterior concrete, stucco, and brick masonry substrates:
 - 1. Semi-gloss Acrylic-Enamel Finish:
 - a. Primer: Pittsburgh® Paints; 4-603 Perma-Crete® Int/ Ext Alkali Resistant Primer (99 g/L VOC); 1.2 to 1.5 Dry Mils.
 - b. Intermediate: Pittsburgh® Paints; 6-900 Series SpeedHide® Exterior House and Trim Semi-gloss Acrylic Latex (131 VOC); 0.9 to 1.1 Dry Mils.
 - c. Finish Coat: Pittsburgh® Paints; 6-900 Series SpeedHide® Exterior House and Trim Semi-gloss Acrylic Latex (131 VOC); 0.9 to 1.1 Dry Mils.

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- B. Concrete Unit Masonry: Provide the following finish systems over exterior concrete unit masonry:
 - 1. Semigloss Acrylic-Enamel Finish:
 - a. Primer: Pittsburgh® Paints; 6-7 SpeedHide® Int/Ext Masonry Block Filler Latex (14.00 g/L VOC); 5.1 to 14.7 Dry Mils.
 - b. Intermediate: Pittsburgh® Paints; 6-900 Series SpeedHide® Exterior House and Trim Semi-gloss Acrylic Latex (131 g/L VOC); 0.9 to 1.1 Dry Mils.
 - c. Finish Coat: Pittsburgh® Paints; 6-900 Series SpeedHide® Exterior House and Trim Semi-gloss Acrylic Latex (131 g/L VOC); 0.9 to 1.1 Dry Mils.
- C. Exterior Gypsum Soffit Board: Provide the following finish systems over exterior gypsum soffit board:
 - 1. Flat Acrylic Finish:
 - a. Primer: Pittsburgh® Paints; 6-609 SpeedHide® Exterior House and Trim Wood Primer Flat (89 g/L VOC); 1.3 to 1.6 Dry Mils.
 - b. Intermediate: Pittsburgh® Paints; 6-610 Series SpeedHide® Exterior Flat Acrylic Latex (96 g/L VOC); 1.0 to 1.2 Dry Mils.
 - c. Finish Coat: Pittsburgh® Paints; 6-610 Series SpeedHide® Exterior Flat Acrylic Latex (96 g/L VOC); 1.0 to 1.2 Dry Mils.
- D. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 - 1. Full-Gloss Acrylic-Enamel Finish:
 - a. Primer: Pittsburgh® Paints; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils.
 - b. Intermediate: Pittsburgh® Paints; 90-374 Series Pitt-Tech® Int/Ext High Gloss DTM Industrial Enamels (192 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils.
 - c. Finish Coat: Pittsburgh® Paints; 90-374 Series Pitt-Tech® Int/Ext High Gloss DTM Industrial Enamels (192 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils.

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- E. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
 - 1. Full-Gloss Acrylic-Enamel Finish:
 - a. Primer: Pittsburgh® Paints; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils.
 - b. Intermediate: Pittsburgh® Paints; 90-374 Series Pitt-Tech® Int/Ext High Gloss DTM Industrial Enamels (192 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils.
 - c. Finish Coat: Pittsburgh® Paints; 90-374 Series Pitt-Tech® Int/Ext High Gloss DTM Industrial Enamels (192 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils.

3.5 INTERIOR PAINT SCHEDULE

- A. Concrete and Masonry (Other Than Concrete Unit Masonry): Provide the following paint systems over interior concrete and brick masonry substrates:
 - 1. Satin Acrylic Enamel Finish:
 - a. Primer: Pittsburgh® Paints; 4-603 Perma-Crete® Int/ Ext Alkali Resistant Primer (99 g/L VOC); 1.2 to 1.5 Dry Mils.
 - b. Intermediate: Pittsburgh® Paints; 6-3511 Series SpeedHide® Interior Satin Acrylic Latex (46 g/L VOC); 1.3 to 1.5 Dry Mils.
 - c. Finish Coat: Pittsburgh® Paints; 6-3511 Series SpeedHide® Interior Satin Acrylic Latex (46 g/L VOC); 1.3 to 1.5 Dry Mils.
- B. Concrete Masonry Unit: Provide the following finish systems over interior concrete masonry:
 - 1. Satin Acrylic Enamel Finish:
 - a. Primer: Pittsburgh® Paints; 6-7 SpeedHide® Int/Ext Masonry Block Filler Latex (14.00 g/L VOC); 5.1 to 14.7 Dry Mils.
 - b. Intermediate: Pittsburgh® Paints; 6-3511 Series SpeedHide® Interior Satin Acrylic Latex (46 g/L VOC); 1.3 to 1.5 Dry Mils.
 - c. Finish Coat: Pittsburgh® Paints; 6-3511 Series SpeedHide® Interior Satin Acrylic Latex (46 g/L VOC); 1.3 to 1.5 Dry Mils.

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- C. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Satin Acrylic Enamel Finish:
 - a. Primer: Pittsburgh® Paints; 6-2 SPEEDHIDE® Interior Latex Sealer Quick-Drying (98.00 g/L VOC); 1.0 to 1.3 Dry Mils.
 - b. Intermediate: Pittsburgh® Paints; 6-3511 Series SpeedHide® Interior Satin Acrylic Latex (46 g/L VOC); 1.3 to 1.5 Dry Mils.
 - c. Finish Coat: Pittsburgh® Paints; 6-3511 Series SpeedHide® Interior Satin Acrylic Latex (46 g/L VOC); 1.3 to 1.5 Dry Mils.
- D. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Satin Acrylic Enamel Finish:
 - a. Primer: Pittsburgh® Paints; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils.
 - b. Intermediate: Pittsburgh® Paints; 6-3511 Series SpeedHide® Interior Satin Acrylic Latex (46 g/L VOC); 1.3 to 1.5 Dry Mils.
 - c. Finish Coat: Pittsburgh® Paints; 6-3511 Series SpeedHide® Interior Satin Acrylic Latex (46 g/L VOC); 1.3 to 1.5 Dry Mils.
- E. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 - 1. Satin Acrylic Enamel Finish:
 - a. Primer: Pittsburgh® Paints; 90-712 Series Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel (123 g/L VOC compliant as anti-corrosive product); 2.0 to 3.0 Dry Mils.
 - b. Intermediate: Pittsburgh® Paints; 6-3511 Series SpeedHide® Interior Satin Acrylic Latex (46 g/L VOC); 1.3 to 1.5 Dry Mils.
 - c. Finish Coat: Pittsburgh® Paints; 6-3511 Series SpeedHide® Interior Satin Acrylic Latex (46 g/L VOC); 1.3 to 1.5 Dry Mils.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes following types of signs:
 - 1. Reflective vehicular directional and information signs (V-Signs)
 - 2. Reflective regulatory signs (R-Signs)
 - 3. Non-reflective pedestrian directional and informational signs (PP-Signs)
 - 4. PVC Pipe Clearance Signs (PVC-Signs)
 - 5. Exterior non-illuminated panel signs (EP-Signs)

1.3 SUBMITTALS

- A. General: Submit following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, mounting heights, anchors, grounds, reinforcement, accessories, layout, spacing, dimensions and installation details.
 - 1. Provide message list for each sign required, including large-scale details of wording, artwork as shown on drawings, and layout of lettering.
 - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
- D. Samples: Provide following samples of each sign component for verification of compliance with requirements indicated.

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1. Samples of each sign type (V-, R-, PP-, EP-, etc), on not less than 6-in. squares of extrusion, sheet or plate, showing full range of colors to be provided.
 2. Dimensional characters and castings: Full size sample showing character, material, texture, finish, color, style and attachment method.
- E. Maintenance Data: For signage cleaning and maintenance requirements to be included in maintenance manual.

1.4 QUALITY ASSURANCE

- A. Qualifications: Manufacturers: Sign manufacturer shall have completed a minimum of 3 projects in last 3 years with similar materials and methods of manufacture as required for this project.
- B. Where warranties are required, manufacturer and/or installers shall be authorized by the entity providing the warranty.
- C. All completed signs shall be free from defects in materials and workmanship and effectively present specified message under both day and night viewing conditions. Sign faces shall be reasonably smooth, shall exhibit uniform color and brightness over entire background surface and shall not appear mottled, streaked, or stained when viewed either in ordinary daylight or incidental beams of automobile headlamps.
- D. Support structures for signs that are free-standing or extending from any exterior surface of the building, including but not limited roof level parking signs on cantilever supports, shall be designed in accordance with ASCE 7-98's requirements for wind loads.
- E. Regulatory Requirements: Comply with Americans with Disabilities Act (ADA) and state and local codes as adopted by authorities having jurisdiction. Signs affected may include, but are not limited to:
1. Permanently Designated Rooms and Spaces: A-Signs
 2. Fire Doors
 3. Room Capacity
 4. Live Load Capacity
 5. Elevator Signs
 6. Stairway Identification
 7. Area of Rescue Assistance identification
- F. Single-Source Responsibility: For each separate required type of sign as defined herein, obtain signs from a single firm specializing in this type of work so that there will be undivided responsibility for such work.
- G. Design Criteria: Drawings indicate sizes, profiles, and dimensional requirements of signs. Other signs with deviations from indicated

dimensions and profiles may be considered, provided deviations do not change design concept. Burden of proof of equality is on proposer.

- H. Coordinate sign placement with structural configuration and lighting location. Before sign installation, arrange meeting with Engineer/Architect and lighting installer at site to review sign placement. Additional compensation not allowed for relocating signs after installation if relocation required due to conflicts with lighting or structure.
- I. Provide written 5-year full replacement warranty to Owner that all signage will be free of defects due to workmanship and materials including, but not limited to, fading, peeling, delamination, and installation. With no additional cost to Owner, repair all defects that develop during warranty period and all damage to other Work due to such defects. NOTE: Additional warranties apply to specific sign types and products, as specified herein.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting and mounting. Where sizes of signs may be affected by dimensions of surfaces on which they are installed, verify dimensions by field measurement. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.6 COORDINATION

- A. For signs to be supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for said devices. Furnish templates for installation.
- B. Coordinate location of remote transformers with building construction. Ensure that transformers are accessible after completion of Work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Product: Where named products are specified, subject to compliance with requirements specific to this project, provide either named product or an equivalent product by one of the other manufacturers specified.
- B. Manufacturers: Subject to compliance with requirements specific to this project, manufacturers listed in Part 2 are considered to have been prequalified in conformance with paragraph 1.4.A and B of this section:
 - 1. Manufacturers of panel signs, including V, R, PVC and EP signs

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- a. ABC Architectural Signing System, Division of Nelson-Harkins Industries.
- b. Allenite, a Division of Allen Marking Products, Inc.
- c. Andco Industries Corp.
- d. APCO Graphics, Inc.
- e. Architectural Graphics, Inc.
- f. ASI Sign Systems, Inc.
- g. Best Manufacturing Co.
- h. Interstate Highway Sign Corp
- i. Henry Graphics
- j. Jarob Design, Inc.
- k. Pannier Graphics
- l. Tapco
- m. Vomar Products, Inc.
2. Manufacturers of PP-Signs:
 - a. Ace Sign Systems, Inc.
 - b. Advance Corporation; Braille-Tac Division
 - c. Architectural Graphics, Inc.
 - d. ASI Sign Systems, Inc.
 - e. Bunting Graphics, Inc.
 - f. InPro Corporation
 - g. Nelson-Harkins Industries
 - h. Norquist Sign Company, Inc.
 - i. Poblocki Sign Company, LLC
 - j. Seton Identification Products
 - k. Volmar Products, Inc.
 - l. Western Remac, Inc.

2.2 MATERIALS

- A. Graphics
 1. Graphics shall be highest quality with sharp lines and smooth curves. Images shall be uniform colors and free from streaks or spotting.
 2. Content and Style: Provide sign copy that complies with requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.
 3. Pressure applied graphics:
 - a. Where pressure-applied graphics applied to a painted background are specified, the paint shall be flat, opaque acrylic polyurethane as recommended by manufacturer of substrate and graphic media.
 - b. Where pressure-applied, reflective graphics on an opaque painted background are specified, letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electrocut Engineer Grade Sheeting Series 3260 material, colors as noted on drawings or equivalent. Edges shall be sealed per manufacturer recommendation.

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- c. Where pressure-applied, reflective graphics on a reflective background are specified, the sheeting material shall be 3M Scotchlite High Intensity Grade Sheeting Series 3870 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01. The letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electronic Cutable Film Series 1170, colors as noted on drawings or equivalent.
 - d. Where pressure-applied, non-reflective graphics are specified, letters shall be digitally produced, and cut by computer-driven processes from 3M Scotchcal Electrocut 7725 film. Sign faces shall be clear coated with UV inhibitor and vandal resistor as recommended by sheeting manufacturer.
 - e. Where electronically cut letters and symbols are specified, the inside corners shall be rounded using the largest radius consistent with acceptable appearance. Minimum radius shall be 1/8 inch on a 3 inch letter. Use prespacing tape as recommended by manufacturer of sheeting as a carrier for letters, numerals and symbols.
 - 4. All products specified to employ 3M sheeting, films, or other components shall be guaranteed and backed by 3M MCS Warranty or equivalent.
- B. Paints:
- 1. All paints shall be a type made for surface material to which it is applied, and recommended by manufacturer. Exact identification shall be noted on shop drawings, with data describing application method, if other than air-drying. Prohibited: paint or ink that will fade, discolor, or delaminate due to UV or heat exposure.
 - 2. All colors for which color match specified shall be approved by Architect prior to production.
 - 3. Acceptable manufacturers and suppliers of inks for silk-screening shall be only those materials recommended by the manufacturer of the sheeting and as required for 3M MCS warranty, or equivalent, where applicable.
 - 4. Paints: all materials best quality. Products of DuPont de Nemours & Company, Pittsburgh Plate Glass Company, Glidden, Matthews or Sherwin-Williams acceptable.
 - a. Opaque background for pressure applied graphics: Two part acrylic polyurethane, low gloss. Care shall be taken to provide proper curing so that outgassing does not occur after application of sheeting and/or graphics.
 - b. Painted graphics on steel doors: Refer to Painting specification section 09910.3.6.C. Ferrous metal paint

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- selection for door base. Graphics paint to be compatible with base paint.
 - c. Base for painted graphics on concrete and concrete masonry units to be prepared per Paint specifications. Graphics two part acrylic polyurethane, low gloss.
 - d. High gloss enamel base: Graphics medium to be determined by installer. Primer may be required.
 - 5. Applied color shall conform to color and accelerated weathering requirements of FP-79 and shall not be removable when tested by Film Adhesion Test and by Film Hardness Test.
- C. Color Schedule:
- 1. Blue – to match Pantone 2945 U
 - 2. Yellow – to match Pantone Yellow 012 U
 - 3. Red – to match Pantone Red 032 UP
 - 4. Green – to match Pantone 362 U
 - 5. White – to match Pantone Bright White 11-0601 TPX
 - 6. Black – to match Pantone Black U
- D. Blank Panels: Comply with requirements indicated for materials, thickness, finish, color, design, shape, size, and details of construction.
- 1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 0.0625 in. measured diagonally.
 - 2. The back side and edges of all panel signs shall be painted with acrylic polyurethane, color to match the specified background color.
 - 3. Edge Condition: Square cut.
 - 4. Corner Condition: 1.5 in. radius unless otherwise indicated on Drawings.
 - 5. Where fiberglass reinforced plastic (FRP) panels are specified, panels shall be manufactured of clear resin or UV stabilized, acrylic-modified polyester resin reinforced with high solubility, chopped strand fiberglass mat. Glass fibers shall not be readily discernable on sign face. In addition sign shall have a glass content of no less than 28% of total sign weight. FRP panels which outgas and cause bubbling of sheeting will not be accepted. Sign shall meet following:
 - a. Ambient temperature range of –50° F to +300° F.
 - b. Minimum Barcol hardness of 50, tensile strength of 12,000 psi, compressive strength of 20000 psi and flexural strength of 18000 psi.
 - c. Minimum impact strength of 6 ft lbs/in notch with fire resistance of 500 degree F.
 - 6. Where aluminum panels are specified, meet following:
 - a. Provide aluminum sheet of 6061-T6 or 5052-H38 alloys and temper recommended by aluminum producer or finisher for use type and finish indicated, and with not less

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than strength and durability properties specified in ASTM B209 for 5005-H15.

- b. Aluminum extrusions shall be of alloy and temper recommended by aluminum producer for type of use and finish and with not less than strength and durability properties specified in ASTM B221 for 6063-T5.
- c. Panels shall be etched, degreased, flat, and free of ragged edges. Radius corners by stamping. All signs of same size shall be totally uniform in size. Surface shall be completely clear of dust and dirt before finishes applied.
- d. Panels to receive 3M sheeting and/or paint shall be treated with an anodizing conversion coating to provide resistance to corrosion and white rust formation. Conversion coating may be:
 - 1) Chromate, meeting ASTM B449 class 2. Coating weight should be 10 to 35 mg per sq ft with a median of 25 mg per square foot. Coating shall not be dusty and shall be tightly bonded within itself and to the aluminum substrate.
 - 2) Non-chromate coatings must meet the requirements for ASTM B449 class 1 chromate coatings. The non-chrome coating shall be adherent and non-powdery. Adhesion of air dried acrylic coating shall meet ASTM D 3359 or ASTM D 4541 and must be equivalent to that of the coating on chromate coated aluminum of the same alloy.
- e. Fabricate aluminum signs with adequately sized, full-length stiffener members as indicated on Drawings.

E. V-Signs: Reflective vehicular signs

- 1. Base materials:
 - a. Aluminum with pressure-applied letters.
- 2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed:
 - a. Pressure applied reflective letters/symbols

F. R-Regulatory signs

- 1. Base material: Aluminum:
- 2. R signs shall have reflective messages and reflective background using either silk screening or pressure applied reflective letters and symbols.

G. PP-Pedestrian Panel Wayfinding and Directional Signs

- 1. Provide smooth, uniform surfaces with messages and characters having uniform faces, sharp corners and precisely-formed lines and profiles, and as follows:
- 2. Sign faces to be milled polycarbonate with painted background and contrasting copy and graphics. Material as best suited to

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provide the finish and strength required to comply with ADA regulations and requirements.

- a. Thickness: 0.25 inch.
 - b. Colors:
 - 1) Field and exposed edges: Color No. 1 – match Benjamin Moore Classic Color HC-145
 - 2) Letters and Graphics: White
 - c. Installed dimensional tolerances: 1/16 inch.
 3. Sign Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Square.
 4. Mounting: Surface mounted with manufacturer approved two-sided tape or adhesive.
 5. Text and Typeface: Accessible raised characters and Braille. Finish raised characters to contrast with background color, and finish Braille to match background color. Flat faces of the raised letters and symbol graphics to be evenly and opaquely colored using silkscreen tipping with enamel ink suitable for printing in the sign face material.
 6. Braille to comply with relevant ADA regulations and requirements indicated for size, style, spacing, content, position and color. Contractor to translate sign copy to appear in Braille.
- H. PVC-Signs: PVC pipe clearance signs shall have pressure applied letters on painted PVC pipe.
1. Electronically cut letters: 3M Scotchlite 3840 reflective sheeting.
 2. 10 in. diameter, Schedule 40 PVC pipe, Corrosion Fluid Products Corporation, Addison, IL, or accepted equivalent.
 3. Paint: "Spraylat" Lacryl B No. 482 High Hiding Black. Meet Lacryl system specifications for painting on PVC.
- I. EP-Signs: Exterior Non-Illuminated Panel Signs
1. Sign design, construction fabrication and assembly shall be contractor responsibility. Where free-standing, supports shall meet AASHTO Standard Specifications for Highway Signs, Luminaries and Traffic Signals (Latest edition.) FRP or aluminum panels are acceptable. Wood not acceptable.
 2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed:
 - a. Pressure applied reflective letters/symbols
 - b. Silk screened.
 3. No buckling, weaving, or oil canning of face panels will be accepted.
 4. Sign mounting to be as noted as drawings from among following:
 - a. Wall or ceiling mount: Provide mounting channel brackets as required by sign size and location.
 - b. Post mount: Sign to be mounted on aluminum posts at both ends, with base plate bolted to concrete foundation to below local frost depth or a minimum of 2'6", which ever is

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- greater. Coordinate anchor bolt locations with general contractor.
- c. Flag mount: Sign to be mounted on single aluminum post, with base plate bolted to concrete foundation to below local frost depth or a minimum of 2'6", which ever is greater. Coordinate anchor bolt locations with general contractor.
- d. Concrete pedestal mount: Sign to be mounted on concrete pedestal of dimensions detailed on drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.
- e. Aluminum pedestal mount: Provide aluminum pedestal cover per drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.
- f. Overhead mount: Where overhead signs are to be mounted over roadways, support frame shall be designed in accordance with state department of transportation requirements for overhead signs.
- 5. All fasteners and brackets to be non-corrosive.
- J. Fasteners and Supports:
 - 1. Bolts, nylon insert lock nuts: ASTM A 320, Grade B stainless steel.
 - 2. Rivets for signs: ASTM B 316, Alloy 6063-T61 or equivalent. Aluminum alloy blind rivets of self-plugging variety may be substituted for solid aluminum alloy rivets, subject to acceptance by Engineer/Architect.
 - 3. Use concealed fasteners fabricated from metals not corrosive to sign material and mounting surface.
 - 4. Anchors and Inserts: Use nonferrous metal or hot-dipped 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.
 - 5. Sign posts: ASTM A 499 Grade 60 or ASTM A 576, Grade 1080 and meeting mechanical properties specified in ASTM A 499 for Grade 60 steel.
 - 6. Posts shall be zinc coated per ASTM A 123. Posts shall be straight, with smooth, uniform finish, free from defects affecting strength, durability, or appearance. Punch bolt holes such that post face shall be smooth and even. All holes and ends shall be burr free. After all fabrication, flow coat posts with durable, exterior type, rust inhibiting paint. Paint color: black, unless otherwise indicated on Drawings.
- K. Cantilever Sign Supports:
 - 1. Pipe for poles and arms: steel pipe, ASTM A53, Grade B, Type E or S.

2. Gusset, flange, and base plates: ASTM A 36.
3. Castings: Free of sharp edges and irregularities. Pole top and end cap castings: ASTM A 126, Class A.
4. Bolts: Connect arm connection flanges with galvanized high strength steel bolts, nuts, and washers per ASTM A 325. Hot dip galvanized fasteners per ASTM A 153. Galvanized nuts shall be tapped oversized per ASTM A 563, and Supplementary requirement S1, "Lubricant and Test for Coated Nuts."
5. Welding: Applicable requirements of Sections of Division 5.

PART 3 EXECUTION

3.1 SURFACE PREPARATION OF SUBSTRATE FOR PAINTED SIGNS

- A. Prepare and clean in strict accordance with paint manufacturer's instructions and as specified here, for each substrate condition.
- B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so contaminants from cleaning process will not fall onto wet, newly painted surfaces.
- C. Cementitious Surfaces:
 1. Prepare surfaces to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and, by roughening as required, glaze.
 2. Determine alkalinity and moisture content of surfaces to be painted by appropriate testing. If surfaces found to be sufficiently alkaline to cause blistering and burring of finish paint, correct before painting. Do not paint on surfaces with moisture content exceeds manufacturer's limits.
- D. Ferrous Metals: Clean uncoated ferrous surfaces of oil, grease, dirt, loose mill scale, and other foreign substances by solvent or mechanical cleaning. Clean previously coated metals in accordance with manufacturer recommendation.

3.2 MATERIALS PREPARATION FOR PAINTED SIGNS

- A. Mix and prepare painting materials per manufacturer's directions.
- B. Store materials not in use in tightly covered containers. Keep all containers clean, free of foreign materials and residue.
- C. Stir materials before applying to produce uniform mixture, and stir as required during application. Do not stir surface film into material. Remove film and strain material before using if necessary.

3.3 INSTALLATION

- A. General: Locate signs where shown using mounting methods of type described and in compliance with manufacturer's instructions. Install sign units level, plumb, and at height shown, with sign surfaces free from appearance defects.
- B. For drilled anchors in concrete, verify location of embedded reinforcing steel, post-tensioning, or pre-stressing cables prior to installation.
- C. Wall Mounted Panel Signs: Attach to wall surfaces with Hilti "Hit" anchors or ITW Ramset/Red Head Hammer Set anchors into concrete or masonry surfaces as shown on Drawings. DO NOT OVERDRIVE anchors, as overdriven anchors will damage sign faces and spall concrete.
- D. Bracket Mounted Units: Provide manufacturer's standard brackets, fittings, and hardware as appropriate for mounting signs which project at right angles from walls or ceilings. Attach brackets securely to walls or ceilings with concealed fasteners and anchors per manufacturer's directions
- E. Installation of signs shall conform to requirements of Americans with Disabilities Act (ADA) and/or state or local accessibility standards.

3.4 CLEANING AND PROTECTION

- A. At completion of installation, clean soiled sign surfaces in accordance with manufacturer's instructions. Protect units from damage until acceptance by Owner.
- B. Cleanup: During progress of Work, remove from site all discarded materials and rubbish at end of each day.
- C. Upon completion of painting, clean all paint spattered surfaces. remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- D. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing. Correct any damage by cleaning, repairing, or replacing, and repainting, as acceptable to Engineer/Architect.
- E. Provide "Wet Paint" signs as required.

END OF SECTION

SECTION 10 26 13

CORNER GUARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Corner guards.

1.2 PERFORMANCE REQUIREMENTS

- A. Corner Guards: Resist lateral impact force of 100 lbs. at any point without damage or permanent set.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Samples: Submit sections of corner guard illustrating component design, configuration, color and finish.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.

1.4 FIELD MEASUREMENTS

- A. Verify that field measurements are as instructed by the manufacturer.

1.5 COORDINATION

- A. Coordinate work under provisions of Section 01 30 00.
- B. Coordinate the work with wall or partition sections for installation of concealed blocking or anchor devices.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Pawling Corporation, 32 Nelson Hill Rd., P.O. Box 200, Wassaic, NY 12592. Ph: (800) 431-3456, www.pawling.com

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- B. Substitutions: Under provisions of Section 01 60 00.

2.2 MANUFACTURED UNITS

- A. Corner Guard: CG-1 Pro-Tek® Heavy-Duty Corner Guards as manufactured by Pawling Corporation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 01 30 00.
- B. Verify that rough-in for components are correctly sized and located.

3.2 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.
- B. Install corner guard from above wall base full height to ceiling above.
- C. Coordinate installation of vinyl fabric wall covering with corner guard.

END OF SECTION

SECTION 10 44 00

FIRE EXTINGUISHER CABINETS AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire Extinguisher Cabinets.
- B. Fire Extinguishers
- C. Accessories

1.2 REFERENCES

- A. UBC 43-6 (ASTM E 814-83) - Fire rated cabinets fabricated in accordance to measure resistance performance.
- B. Americans with Disabilities Act 1990 - Maximum 4 inch cabinet projection for corridors.

1.3 QUALITY ASSURANCE

- A. Provide fire extinguisher cabinets and accessories by a single manufacturer.
- B. Conform to UBC 43-6 (ASTM E 814-83) for fire resistive wall performance where necessary.
- C. Conform to Americans with Disabilities Act 1990 on maximum cabinet projection of 4 inches in corridors where necessary.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide extinguisher operational features, color and finish, and anchorage details.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01 70 00.

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1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Package, handle, deliver and store at the job site in a manner that will avoid damage. Damaged equipment will be rejected.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Extinguishers and Cabinets: J.L. Industries, Inc.
- B. Safety Flammable Cabinets: Jamco Products, Inc.
- C. Other acceptable manufacturers offering equivalent products:
 - 1. Larsen's Manufacturing Company
 - 2. Modern Metal Products
 - 3. Potter-Roemer
 - 4. Watrous
- D. Substitutions: Under provisions of Section 01 60 00.

2.2 EXTINGUISHERS

- A. Fire Extinguishers: Cosmic 10E Multi-Purpose Dry Chemical, UL rating 4A-60BC. (provide one extinguisher per cabinet and bracketed locations)

2.3 CABINETS

- A. Fire Extinguisher Cabinets: (refer to plan for locations)
 - 1. Model: Academy Series 1027
 - 2. Door Style: G- Full glass with pull and Saf-T-Lok
 - 3. Door Glazing: 17
 - 4. Finish: No. 180 clear anodized aluminum
 - 5. Surface Mounted in all cases; no recessed or semi-recessed cabinets required.
- B. Safety Flammable Cabinets: (one only; to be located in Room 105)
 - 1. Model: BM
 - 2. Capacity: 44 gallons
 - 3. Manual close doors
 - 4. Galvanized steel shelves
 - 5. Finish: Yellow (YP)

2.4 ACCESSORIES

- A. Wall Bracket: #MB 846 (two required; one each at rooms B03 and 105)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify wall openings under provisions of Section 01 30 00.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at 5'-4" above finished floor to the top of the cabinet.
 - 1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
 - 2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.
- B. Remove and replace damaged or defective units.

END OF SECTION

SECTION 14 24 23

HYDRAULIC ELEVATOR - PASSENGER

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: Hydraulic passenger elevators as shown and specified. Elevator work includes:
 - 1. Standard pre-engineered hydraulic passenger elevators.
 - 2. Elevator car enclosures, hoistway entrances and signal equipment.
 - 3. Jacks.
 - 4. Operation and control systems.
 - 5. Accessibility provisions for physically disabled persons.
 - 6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
 - 7. Materials and accessories as required to complete the elevator installation.
- B. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Section 300 for hydraulic elevators. State or local requirements must be used if more stringent.
 - 1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.
 - 2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
 - 3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
 - 4. Elevator hoistways shall have barricades, as required.
 - 5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
 - 6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
 - 7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
 - 8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42"

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- minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
9. Machine room to be enclosed and protected.
 10. Machine Room temperature must be maintained between 55° and 90° F.
 11. If machine room is remote from the elevator hoistway, clear access must be available above the ceiling or metal/concrete raceways in floor for oil line and wiring duct from machine room.
 12. Access to the machinery space and machine room must be in accordance with the governing authority or code.
 13. Provide an 8" x 16" cutout through machine room wall, for oil line and wiring duct, coordinated with elevator contractor at the building site.
 14. All wire and conduit should run remote from either the hoistways or the machine room.
 15. When heat, smoke or combustion sensing devices are required, connect to elevator machine room terminals. Contacts on the sensors should be sided for 120 volt D.C.
 16. Install and furnish finished flooring in elevator cab.
 17. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
 18. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
 19. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
 20. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
 21. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
 22. General Contractor shall fill and grout around entrances, as required.
 23. Elevator sill supports shall be provided at each opening.
 24. All walls and sill supports must be plumb where openings occur.
 25. For applications with jack hole, free and clear access to the elevator pit area for the jack hole-drilling rig is required.
 26. Where jack hole is required, remove all spoils from jack hole drilling.
 27. When not provided by Elevator Contractor, jack hole shall accommodate the jack unit. If required the jack hole is to be

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- provided in strict accordance with the elevator contractor's shop drawings.
28. Locate a light fixture and convenience outlet in pit with switch located adjacent to the access door.
 29. A light switch and fused disconnect switch for each elevator should be located inside the machine room adjacent to the door, where practical, per the National Electrical Code (NFPA No. 70).
 30. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway (or in the machine room).
 31. For signal systems and power operated door: provide ground and branch wiring circuits, including main line switch. For car light and fan: provide a feeder and branch wiring circuits, including main line switch.
 32. Wall thickness may increase when fixtures are mounted in drywall. These requirements must be coordinated between the general contractor and the elevator contractor.
 33. Provide supports, patching and recesses to accommodate hall button boxes, signal fixtures, etc.
 34. Locate telephone and convenience outlet on control panel.

1.2 REFERENCE STANDARDS

- A. American National Standards Safety Code for Elevators.
- B. National Electric Code.
- C. State of Minnesota Code.

1.3 SYSTEM DESCRIPTION

- A. The intent of this specification is to provide standard oil-hydraulic elevators.

1.4 SUBMITTALS

- A. Product data: When requested, the elevator contractor will provide standard cab, entrance and signal fixture data to describe product for approval.
- B. Shop drawings: Prepare and submit shop drawings to the Architect for approval in accordance with the General Conditions. No materials shall be fabricated until such drawings have been approved.
 1. Show equipment arrangement in the machine room/control space, pit and hoistway. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
 2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.

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3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
 4. Indicate electrical power requirements and branch circuit protection device recommendations.
- C. Metal Finishes: Upon request, standard metal samples provided.
- D. Operation and maintenance data. Include the following:
1. Owner's Manual and Wiring Diagrams.
 2. Parts list, with recommended parts inventory.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An approved manufacturer with minimum fifteen years' experience in manufacturing, installing, and servicing elevators of the type required for the project.
1. Must be the manufacturer of the power unit, controller, signal fixtures, door operators cab, entrances, and all other major parts of the elevator operating equipment.
 - a. The major parts of the elevator equipment shall be manufactured in the United States, and not be an assembled system.
 2. The manufacturer shall have a documented, on-going quality assurance program.
 3. ISO-9001:2000 Manufacturer Certified
 4. ISO-14001:2004 Environmental Management System Certified
- B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than fifteen years of satisfactory experience installing elevators equal in character and performance to the project elevators.
- C. Fire-rated Entrance Assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, UL10(B), and NFPA 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory.
- D. Inspection and testing: Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
1. Arrange for inspections and make required tests.
 2. Deliver to the Owner upon completion and acceptance of elevator work. The elevator contractor shall obtain and pay for all necessary municipal or state inspections and make such tests as are called for by the regulations for such authorities. These tests shall be made in the presence of the authorized representative of such authorities.

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1.6 DELIVERY, STORAGE AND HANDLING

- A. Manufacturing will deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.
- B. All materials shall be delivered to the site in protective packaging and shall be kept dry at all times.
- C. The general contractor shall assign an area conveniently located to the elevator hoistway for storage of materials and tools during installation.

1.7 WARRANTY

- A. The elevator contractor shall warrant the equipment installed by him under these specifications against defects in materials and workmanship and will correct any defects not due to ordinary wear or test or improper use or care which may develop within one (1) year from the date the elevator is complete and place in operation. This warranty is not intended to supplant normal maintenance service and shall not be construed to mean that the elevator contractor will provide free service for periodic examination, lubrication, or adjustment due to normal use, beyond that included in the specification; nor will the elevator contractor correct, without charge, breakage, maladjustments, or other trouble arising from abuse, misuse, improper or unbalanced power supply characteristics, improper or inadequate maintenance, or other causes beyond his control. If there is more than one unit in this specification, this section shall apply separately to each unit as completed and placed in operation.
- B. The elevator contractor shall furnish maintenance and call-back service on the elevator after it is complete and placed in operation for a period of one (1) year. This service shall consist of periodic examinations of the equipment, adjustments, lubrication, cleaning supplies and parts to keep this equipment in proper operation, except such adjustments, lubrication, cleaning, supplies and part to keep the equipment in proper operation, except such adjustments, parts or repairs made necessary by abuse, misuse or any other cause beyond the control of the elevator contractor. All work will be done by trained employees of the elevator contractor during regular working hours of the trade, and shall not be assigned or sub-let to any other elevator company. The elevator contractor shall be locally staffed for warranty service.
- C. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months from date of Substantial Completion.

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1.8 MAINTENANCE

- A. Furnish maintenance and call back service for a period of 3 months for each elevator from date of Substantial Completion during normal working hours, excluding callbacks. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation.
- B. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer: ThyssenKrupp Elevator, 2591 Dallas Parkway, Suite 600, Frisco, TX 75034, Ph.: (877) 230-0303 Email: sales@thyssenkrupp.com
www.thyssenkruppelevator.com
- B. Other manufacturers with similar equipment shall inform both the Architect and General Contractor of any deviations from these standards. Deviations which require changing the hoistway size shall be coordinated with the General Contractor. General contractors bid prices shall reflect any such changes, as no additional compensation will be granted for changes required to accommodate a different manufacturer.

2.2 MATERIALS, GENERAL

- A. Colors, patterns, and finishes: As selected by the Architect from manufacturer's standard colors, patterns, and finish charts.
- B. Steel:
 - 1. Shapes and bars: Carbon.
 - 2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
 - 3. Finish: Factory-applied baked enamel.
- C. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness.
- D. Flooring: By others.

2.3 HOISTWAY EQUIPMENT

- A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood subfloor. Underside of the platform shall be fireproofed. The car platform shall be designed and

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fabricated to support one-piece loads weighing up to 25% of the rated capacity.

- B. Sling: Steel stiles affixed to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
- C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.
- D. Guide Shoes: Slide guides shall be mounted on top and bottom of the car.
- E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on a steel template that is fastened to the pit floor or continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
- F. Jack: Jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to insure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless telescopic 3-stage. Two jacks piped together, mounted one on each side of the car with each having three telescopic sections designed to extend in a synchronized manner when oil is pumped into the Assembly. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. A follower guide shall be furnished for the top of the lower two plungers and be guided by rollers running inside a steel guide channel which is firmly attached to the guide rail system. This plunger guide system shall maintain a stabilized support for the plunger sections. Each Jack Assembly shall have check valves built into the assembly to allow for automatically re-syncing the three plunger sections by moving the jack to its fully contracted position.
- G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the landings and correct for overtravel or undertravel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
- H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade readily biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details)

2.4 POWER UNIT

- A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following items:
 - 1. Oil reservoir with tank cover.
 - 2. An oil hydraulic pump.
 - 3. An electric motor.
 - 4. Oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.
- B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.
- C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating shall be selected for specified speed and load.
- D. Control System: Shall be microprocessor based and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure.
- E. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
 - 1. Relief valve shall be externally adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
 - 2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
 - 3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
 - 4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
- F. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.

- G. Oil Type: USDA certified biobased product, ultra-low toxicity, readily biodegradable, energy efficient, high performing fluid made from canola oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Especially formulated for operating in environmentally sensitive areas. USDA certified biobased product, >90% bio-based content, per ASTM D6866

2.5 HOISTWAY ENTRANCES

- A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
 - 1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates, sight guards, and necessary hardware.
 - 2. Main landing door & frame finish: Stainless steel panels, no. 4 brushed finish.
 - 3. Typical door & frame finish: 5WL Rigidized stainless steel panels.
- B. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.
- C. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
 - 1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
 - 2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
 - 3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.
- D. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.6 CAR ENCLOSURE

- A. Car Enclosure:
 - 1. Walls: Walls shall be constructed of 5WL rigidized stainless steel. Cab type TKS, reinforced cold-rolled steel.
 - 2. Canopy: Cold-rolled steel with hinged exit.
 - 3. Ceiling: Suspended type, fluorescent lighting with translucent diffuser mounted in a metal frame.
 - 4. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel.
 - 5. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.

- a. Door Finish: Stainless steel panels: 5WL Rigidized stainless steel.
 - b. Cab Sills: Extruded aluminum, mill finish.
- 6. Handrail: Provide 1.5" diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
- 7. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
- B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station will give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.7 DOOR OPERATION

- A. Door Operation: Provide a direct current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and the door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. Closed-loop, microprocessor controlled motor-driven linear door operator, with adjustable torque limits, also acceptable. AC controlled units with oil checks or other deviations are not acceptable.
 - 1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
 - 2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
 - 3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel will reverse and the door will reopen to answer the other call.
 - 4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer will sound. When the obstruction is removed, the door will begin to close at reduced speed. If the

infra-red door protection system detects a person or object while closing on nudging, the doors will stop and resume closing only after the obstruction has been removed.

5. Limited Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.
 6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then attempt to open six times to try and correct the fault.
 7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then attempt to close six times to try and correct the fault.
 8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.
- B. Door Protection Devices: Provide a door protection system using 150 or more microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.8 CAR OPERATING STATION

- A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Swing return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. All polycarbonate pushbuttons shall be manufactured with Microban® antimicrobial protection. Switches for car light and accessories shall be provided.
- B. Emergency Communications System: Integral phone system provided.
- C. Auxiliary Operating Panel: Not Required
- D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

2.9 CONTROL SYSTEMS

- A. Controller: The elevator control system shall be microprocessor based and software oriented. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
- B. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.
- C. Special Operation: Not Applicable

2.10 HALL STATIONS

- A. Hall Stations, General: Provide buttons with red-illuminating LED halos to indicate that a call has been registered at that floor for the indicated direction. Provide 1 set of pushbutton risers. Provide one pushbutton riser with faceplates having a brushed stainless steel finish.
 - 1. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.
 - 2. All polycarbonate pushbuttons to be manufactured with have Microban® antimicrobial protection.
- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

- A. Oil Hydraulic Silencer: Install an oil hydraulic silencer (muffler device) at the power unit location. The silencer shall contain pulsation absorbing material inserted in a blowout proof housing arranged for inspecting interior parts without removing unit from oil line.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and machine rooms/control space, as constructed and verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 INSTALLATION

- A. Install elevator systems components and coordinate installation of hoistway wall construction.
 - 1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 - 2. Comply with the National Electrical Code for electrical work required during installation.
- B. Jack unit excavation (if required by the type of jack provided): Drill or otherwise excavate below elevator pit construction as required to install the jack unit.
 - 1. Install casing for jack unit.
 - 2. Provide HDPE jack protection system for all in ground jacks.
 - 3. Set casing for jack unit assembly plumb, and partially fill with water settled sand, eliminating voids. Back fill depth shall be sufficient to hold the bottom of the jack in place over time.
- C. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
- D. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- E. Lubricate operating parts of system where recommended by manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required by A17.1 Code and local authorities having jurisdiction. Perform other tests, if any, as required by governing regulations or agencies.
- B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

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3.4 ADJUSTING

- A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.5 CLEANING

- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless stall shall be cleaned with soap and water and dried with a non-abrasive surface; shall not be cleaned with bleached-based cleansers.
- B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

3.6 PROTECTION

- A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.7 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.8 ELEVATOR SCHEDULE

- A. Elevator Qty. 1
 - 1. Elevator Model: Endura Above-Ground (3-Stage)
 - 2. Rated Capacity: 3500 lbs.
 - 3. Rated Speed: 100 ft./min.
 - 4. Operation System: TAC32
 - 5. Travel: 33'-0"
 - 6. Landings: 4 total
 - 7. Openings:
 - a. Front: 4

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- b. Rear: 0
- 8. Clear Car Inside: 6' - 8" wide x 5' - 5" deep
- 9. Cab Height: 8'-0" nominal
- 10. Hoistway Entrance Size: 3' - 6" wide x 7'-0" high
- 11. Door Type: Single Speed
- 12. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
- 13. Seismic Requirements: Zone 1
- 14. Fixture & Button Style: Signa4 Signal Fixtures with Microban® antimicrobial protection.

END OF SECTION

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SECTION 220516 – EXPANSION FITTINGS AND
LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Flexible-hose packless expansion joints.
 - 2. Metal-bellows packless expansion joints.
 - 3. Rubber packless expansion joints.
 - 4. Grooved-joint expansion joints.
 - 5. Pipe loops and swing connections.
 - 6. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide 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 requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.

4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of expansion joint, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

- A. Flexible-Hose Packless Expansion Joints:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Flex Pression Ltd.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Mason Industries, Inc.
 - e. Metraflex Company (The).
 - f. Unisource Manufacturing, Inc.
 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
 4. Expansion Joints for Copper Tubing **NPS 2 (DN 50)** and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and single-braid bronze sheaths with **450 psig at 70 deg F (3100 kPa at 21 deg C)** and **340 psig at 450 deg F (2340 kPa at 232 deg C)** ratings.

- b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 500 psig at 450 deg F (3450 kPa at 232 deg C) ratings.
 - 5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F (2070 kPa at 21 deg C) and 225 psig at 450 deg F (1550 kPa at 232 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F (2890 kPa at 21 deg C) and 315 psig at 450 deg F (2170 kPa at 232 deg C) ratings.
 - 6. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Stainless-steel fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 325 psig at 600 deg F (2250 kPa at 315 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F (4830 kPa at 21 deg C) and 515 psig at 600 deg F (3550 kPa at 315 deg C) ratings.
 - 7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Stainless-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F (1900 kPa at 21 deg C) and 200 psig at 600 deg F (1380 kPa at 315 deg C) ratings.
 - 8. Expansion Joints for Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Stainless-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F (860 kPa at 21 deg C) and 90 psig at 600 deg F (625 kPa at 315 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F (1130 kPa at 21 deg C) and 120 psig at 600 deg F (830 kPa at 315 deg C) ratings.
- B. Metal-Bellows Packless Expansion Joints:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Adesco Manufacturing LLC.
 - b. American BOA, Inc.

- c. [Badger Industries, Inc.](#)
 - d. [Expansion Joint Systems, Inc.](#)
 - e. [Flex Pression Ltd.](#)
 - f. [Flex-Hose Co., Inc.](#)
 - g. [Flex-Weld, Inc.](#)
 - h. [Flexicraft Industries.](#)
 - i. [Flo Fab inc.](#)
 - j. [Hyspan Precision Products, Inc.](#)
 - k. [Mason Industries, Inc.](#)
 - l. [Metraflex Company \(The\).](#)
 - m. [Proco Products, Inc.](#)
 - n. [Senior Flexonics Pathway.](#)
 - o. [Tozen Corporation.](#)
 - p. [U.S. Bellows, Inc.](#)
 - q. [Unaflex.](#)
 - r. [Unisource Manufacturing, Inc.](#)
 - s. [Universal Metal Hose.](#)
 - t. [WahlcoMetroflex.](#)
2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
 3. Type: Circular, corrugated bellows with external tie rods.
 4. Minimum Pressure Rating: **150 psig (1035 kPa)** or **175 psig (1200 kPa)** unless otherwise indicated.
 5. Configuration: Single joint, Single joint with base and double joint with base class(es) unless otherwise indicated.
 6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing **NPS 2 (DN 50)** and Smaller: Solder joint or threaded.
 - b. End Connections for Copper Tubing **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Solder joint or threaded.
 - c. End Connections for Copper Tubing **NPS 5 (DN 125)** and Larger: Flanged.

C. Rubber Packless Expansion Joints:

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Amber/Booth Company, Inc.](#)
 - b. [Flex-Hose Co., Inc.](#)
 - c. [Flex-Weld, Inc.](#)
 - d. [Flexicraft Industries.](#)
 - e. [Garlock Sealing Technologies.](#)
 - f. [General Rubber Corporation.](#)
 - g. [Mason Industries, Inc.](#)
 - h. [Metraflex Company \(The\).](#)
 - i. [Proco Products, Inc.](#)
 - j. [Red Valve Company, Inc.](#)

- k. [Tozen Corporation.](#)
 - l. [Unaflex.](#)
 - m. [Unisource Manufacturing, Inc.](#)
2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
 3. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
 4. Arch Type: Single or multiple arches with external control rods.
 5. Spherical Type: Single or multiple spheres with external control rods.
 6. Minimum Pressure Rating for **NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C).**
 7. Minimum Pressure Rating for **NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (966 kPa) at 200 deg F (93 deg C).**
 8. Minimum Pressure Rating for **NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig (966 kPa) at 180 deg F (82 deg C).**
 9. Material for Fluids Containing Acids, Alkalies, or Chemicals: BR, CSM or EPDM.
 10. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N or CR.
 11. Material for Water: BR, Buna-N, CR, CSM, EPDM or NR.
 12. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.2 GROOVED-JOINT EXPANSION JOINTS

- A. **[Basis-of-Design Product:](#)** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. [Anvil International, Inc.](#)
 2. [Shurjoint Piping Products.](#)
 3. [Victaulic Company.](#)
- B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
- C. Standard: AWWA C606, for grooved joints.
- D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.
- E. Couplings: Five, Seven, Ten or Twelve flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water, EPDM gasket suitable for cold and hot water, and bolts and nuts.

2.3 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides:
 1. **[Basis-of-Design Product:](#)** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Adscos Manufacturing LLC.](#)
 - b. [Advanced Thermal Systems, Inc.](#)

- c. [Flex-Hose Co., Inc.](#)
 - d. [Flex-Weld, Inc.](#)
 - e. [Flexicraft Industries.](#)
 - f. [Hyspan Precision Products, Inc.](#)
 - g. [Mason Industries, Inc.](#)
 - h. [Metraflex Company \(The\).](#)
 - i. [Senior Flexonics Pathway.](#)
 - j. [U.S. Bellows, Inc.](#)
 - k. [Unisource Manufacturing, Inc.](#)
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

- 1. Steel Shapes and Plates: ASTM A 36/A 36M.
- 2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
- 3. Washers: ASTM F 844, steel, plain, flat washers.
- 4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
- 5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-NMEJ-702.
- D. Install grooved-joint expansion joints to grooved-end steel piping

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one or two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
 - 3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 220517 – SLEEVES AND SLEEVE SEALS
FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - 1. Smith, Jay R. Mfg. Co.
 - 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber, NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel, plastic, stainless steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Presealed Systems.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm)] < above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 07920 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07841 "Through-Penetration Firestop Systems."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07620 "Sheet Metal Flashing and Trim."
 - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
 - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07841 "Through-Penetration Firestop Systems."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:

- a. Piping smaller than **NPS 6 (DN 150)**: Cast-iron wall sleeves, galvanized-steel wall sleeves, galvanized-steel-pipe sleeves or sleeve-seal fittings.
 - b. Piping **NPS 6 (DN 150)** and larger: Cast-iron wall sleeves, galvanized-steel wall sleeves or galvanized-steel-pipe sleeves.
- 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than **NPS 6 (DN 150)**: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system, galvanized-steel-pipe sleeves with sleeve-seal system or sleeve-seal fittings.
 - 1) Select sleeve size to allow for **1-inch (25-mm)** annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping **NPS 6 (DN 150)** and larger: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system or galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for **1-inch (25-mm)** annular clear space between piping and sleeve for installing sleeve-seal system.
- 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than **NPS 6 (DN 150)**: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system, galvanized-steel-pipe sleeves with sleeve-seal system or sleeve-seal fittings.
 - 1) Select sleeve size to allow for **1-inch (25-mm)** annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping **NPS 6 (DN 150)** and Larger: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system, galvanized-steel-pipe sleeves with sleeve-seal system or galvanized-steel-pipe sleeves.
 - 1) Select sleeve size to allow for **1-inch (25-mm)** annular clear space between piping and sleeve for installing sleeve-seal system.
- 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than **NPS 6 (DN 150)**: Galvanized-steel-pipe sleeves, PVC-pipe sleeves, stack-sleeve fittings, sleeve-seal fittings, molded-PE or -PP sleeves or molded-PVC sleeves.
 - b. Piping **NPS 6 (DN 150)** and Larger: Galvanized-steel-pipe sleeves, PVC-pipe sleeves or stack-sleeve fittings.

END OF SECTION 220517

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 220518 – ESCUTCHEONS FOR
PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated rough-brass finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated, rough-brass finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
 - 2. Escutcheons for Existing Piping:
 - a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.

- e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated, rough-brass finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
 - i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated rough-brass finish.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
 - D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 220519 – METERS AND GAGES
PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gages.
7. Gage attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.

B. Related Sections:

1. Section 02510 "Water Distribution" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
2. Section 02515 "Facility Fire-Suppression Water-Service Piping" for fire-protection water-service meters outside the building.
3. Section 13930 "Wet-Pipe Sprinkler Systems"
4. Section 13935 "Dry-Pipe Sprinkler Systems" for fire protection pressure gages.
5. Section 13955 "Foam-Water Systems" for fire protection pressure gages.
6. Section 13974 "Fire-Suppression Standpipes" for fire protection pressure gages.
7. Section 15140 "Domestic Water Piping" for water meters inside the building.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.
10. Trerice, H. O. Co.
11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
12. Weiss Instruments, Inc.
13. WIKA Instrument Corporation - USA.
14. Winters Instruments - U.S.

- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with **3-inch (76-mm)**, **5-inch (127-mm)** nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in **deg F (deg C)** deg F and deg C.
- E. Connector Type(s): Union joint, adjustable angle, rigid, back and rigid, bottom with unified-inch screw threads.
- F. Connector Size: **1/2 inch (13 mm)**, with ASME B1.1 screw threads.
- G. Stem: **0.25 or 0.375 inch (6.4 or 9.4 mm)** in diameter; stainless steel.
- H. Window: Plain glass or plastic.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.

- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 or 1.5 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Trerice, H. O. Co.
 - g. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch (114-mm), 5-inch (127-mm), 6-inch (152-mm) nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C)** deg F and deg C.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Metal, Stainless steel.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device rigid, back and rigid, bottom; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

B. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ashcroft Inc.
 - b. Miljoco Corporation.
 - c. REOTEMP Instrument Corporation.
2. Standard: ASME B40.200.

3. Case: Sealed type, plastic; **4-1/2-inch (114-mm)**, **5-inch (127-mm)** or **6-inch (152-mm)** nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C)** deg F and deg C.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Metal or plastic.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device, rigid, back and rigid, bottom; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

C. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide [**product indicated on Drawings**] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Marsh Bellofram.
 - d. Miljoco Corporation.
 - e. Palmer Wahl Instrumentation Group.
 - f. REOTEMP Instrument Corporation.
 - g. Trerice, H. O. Co.
 - h. Weiss Instruments, Inc.
 - i. WIKA Instrument Corporation - USA.
 - j.
2. Standard: ASME B40.200.
3. Case: Sealed type, cast aluminum or drawn steel; **4-1/2-inch (114-mm)** or **6-inch (152-mm)** nominal diameter with back or front flange and holes for panel mounting.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C)** deg F and deg C.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Metal or Stainless steel.
10. Connector Type(s): Union joint, back or bottom; with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

- a. Design for Thermowell Installation: Bare stem.
- 12. Accuracy: Plus or minus 1 percent of scale range.
- D. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Miljoco Corporation.
 - d. REOTEMP Instrument Corporation.
 - e. Trerice, H. O. Co.
 - 2. Standard: ASME B40.200.
 - 3. Case: Sealed type, plastic; **4-1/2-inch (114-mm)** or **6-inch (152-mm)** nominal diameter with back or front flange and holes for panel mounting.
 - 4. Element: Bourdon tube or other type of pressure element.
 - 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C)** deg F and deg C.
 - 7. Pointer: Dark-colored metal.
 - 8. Window: Glass or plastic.
 - 9. Ring: Metal or plastic.
 - 10. Connector Type(s): Union joint, threaded, back or bottom with ASME B1.1 screw threads.
 - 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 12. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by the following:
 - a. Trerice, H. O. Co.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; **6-inch (152-mm)** nominal size.
 - 4. Case Form: Back angle Straight unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in **deg F (deg C)** deg F and deg C.

7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: **3/4 inch (19 mm)**, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Tel-Tru Manufacturing Company.
 - d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - e. Weiss Instruments, Inc.
 - f. WIKA Instrument Corporation - USA.
2. Standard: ASME B40.200.
3. Case: Plastic; **6-inch (152-mm)** nominal size.
4. Case Form: Back angle, Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective with permanently etched scale markings graduated in **deg F (deg C)** deg F and deg C.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: **3/4 inch (19 mm)**, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

C. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Flo Fab Inc.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Tel-Tru Manufacturing Company.
 - e. Trerice, H. O. Co.
 - f. Weiss Instruments, Inc.
 - g. Winters Instruments - U.S.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch (178-mm) or 9-inch (229-mm) nominal size unless otherwise indicated.
4. Case Form: Adjustable angle, Back angle or Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) deg F and deg C.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.

a. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

D. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ernst Flow Industries.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - g. Weiss Instruments, Inc.
 - h. WIKA Instrument Corporation - USA.
 2. Standard: ASME B40.200.
 3. Case: Plastic; 7-inch (178-mm) or 9-inch (229-mm) nominal size unless otherwise indicated.
 4. Case Form: Adjustable angle, Back angle or Straight unless otherwise indicated.
 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C) deg F and deg C.
 7. Window: Glass or plastic.
 8. Stem: Aluminum, Brass, Stainless steel, Aluminum, brass, or stainless steel and of length to suit installation.
- a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.4 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Flo Fab Inc.
 - b. REOTEMP Instrument Corporation.
 - c. Terice, H. O. Co.
 - d. Weiss Instruments, Inc.
 - e. WIKA Instrument Corporation - USA.
 - f. Winters Instruments - U.S.
2. Case: Plastic, Metal; **7-inch (178-mm)** or **9-inch (229-mm)** nominal size unless otherwise indicated.
3. Scale(s): **Deg F (Deg C)**, Deg F and deg C.
4. Case Form: Adjustable angle.
5. Connector: **1-1/4 inches (32 mm)**, with ASME B1.1 screw threads.
6. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
7. Display: Digital.
8. Accuracy: Plus or minus **2 deg F (1 deg C)**.

B. Remote-Mounted, Light-Activated Thermometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Miljoco Corporation.
 - b. Weiss Instruments, Inc.
 - c. Winters Instruments - U.S.
2. Case: Plastic, for wall mounting.
3. Scale(s): **Deg F (Deg C)**, Deg F and deg C.
4. Sensor: Bulb and thermister wire.
 - a. Design for Thermowell Installation: Bare stem.
5. Display: Digital.
6. Accuracy: Plus or minus **2 deg F (1 deg C)**.

2.5 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: **NPS 1/2, NPS 3/4, or NPS 1**, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: **1/2, 3/4, and 1 inch (13, 19, and 25 mm)**, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.6 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Liquid-filled, Sealed, Open-front, pressure relief, Solid-front, pressure relief type(s); cast aluminum or drawn steel; **4-1/2-inch (114-mm)** or **6-inch (152-mm)** nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with [**NPS 1/4 (DN 8)**] [**NPS 1/4 or NPS 1/2 (DN 8 or DN 15)**] [**NPS 1/2 (DN 15)**], ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.

7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa)** psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal, Brass or Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of, Grade B plus or minus 2 percent of middle half of Grade C, plus or minus 3 percent of middle half of Grade D, plus or minus 5 percent of whole scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Flo Fab Inc.
 - d. Marsh Bellofram.
 - e. Miljoco Corporation.
 - f. Noshok.
 - g. Palmer Wahl Instrumentation Group.
 - h. REOTEMP Instrument Corporation.
 - i. Tel-Tru Manufacturing Company.
 - j. Trerice, H. O. Co.
 - k. Weiss Instruments, Inc.
 - l. WIKA Instrument Corporation - USA.
 - m. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; **4-1/2-inch (114-mm)** or **6-inch (152-mm)** nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with [**NPS 1/4 (DN 8)**] [**NPS 1/4 or NPS 1/2 (DN 8 or DN 15)**] [**NPS 1/2 (DN 15)**], ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa)** psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of Grade B, plus or minus 2 percent of middle half of Grade C, plus or minus 3 percent of middle half of Grade D, plus or minus 5 percent of whole scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.

- b. [Ashcroft Inc.](#)
 - c. [Ernst Flow Industries.](#)
 - d. [Flo Fab Inc.](#)
 - e. [Marsh Bellofram.](#)
 - f. [Miljoco Corporation.](#)
 - g. [Noshok.](#)
 - h. [Palmer Wahl Instrumentation Group.](#)
 - i. [REOTEMP Instrument Corporation.](#)
 - j. [Tel-Tru Manufacturing Company.](#)
 - k. [Trerice, H. O. Co.](#)
 - l. [Watts Regulator Co.; a div. of Watts Water Technologies, Inc.](#)
 - m. [Weiss Instruments, Inc.](#)
 - n. [WIKA Instrument Corporation - USA.](#)
 - o. [Winters Instruments - U.S.](#)
2. Standard: ASME B40.100.
 3. Case: Liquid-filled Sealed type; cast aluminum or drawn steel metal; 4-1/2-inch (114-mm) or 6-inch (152-mm) nominal diameter with back or front flange and holes for panel mounting.
 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 5. Pressure Connection: Brass, with NPS 1/4 (DN 8), NPS 1/4 or NPS 1/2 (DN 8 or DN 15) or NPS 1/2 (DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa) psi and kPa.
 8. Pointer: Dark-colored metal.
 9. Window: Glass or plastic.
 10. Ring: Metal or Stainless steel.
 11. Accuracy: Grade A, plus or minus 1 percent of middle half of Grade B, plus or minus 2 percent of middle half of Grade C, plus or minus 3 percent of middle half of Grade D, plus or minus 5 percent of whole scale range.

D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [AMETEK, Inc.; U.S. Gauge.](#)
 - b. [Ashcroft Inc.](#)
 - c. [Miljoco Corporation.](#)
 - d. [Noshok.](#)
 - e. [Palmer Wahl Instrumentation Group.](#)
 - f. [REOTEMP Instrument Corporation.](#)
 - g. [Tel-Tru Manufacturing Company.](#)
 - h. [Trerice, H. O. Co.](#)
 - i. [Weiss Instruments, Inc.](#)
 - j. [WIKA Instrument Corporation - USA.](#)
 - k. [Winters Instruments - U.S.](#)

2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; **4-1/2-inch (114-mm)** or **6-inch (152-mm)** nominal diameter with back or front flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with **NPS 1/4 (DN 8)**, **NPS 1/4 or NPS 1/2 (DN 8 or DN 15)** or **NPS 1/2 (DN 15)**, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in **psi (kPa)** psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of Grade B, plus or minus 2 percent of middle half of Grade C, plus or minus 3 percent of middle half of Grade D, plus or minus 5 percent of whole scale range.

2.7 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with **NPS 1/4 (DN 8)**, **NPS 1/4 or NPS 1/2 (DN 8 or DN 15)** or **NPS 1/2 (DN 15)**, ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, Brass or stainless-steel needle, with [**NPS 1/4 (DN 8)**] [**NPS 1/4 or NPS 1/2 (DN 8 or DN 15)**] [**NPS 1/2 (DN 15)**], ASME B1.20.1 pipe threads.

2.8 TEST PLUGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. National Meter, Inc.
 4. Peterson Equipment Co., Inc.
 5. Sisco Manufacturing Company, Inc.
 6. Trerice, H. O. Co.
 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: **NPS 1/4 (DN 8)** or **NPS 1/2 (DN 15)**, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: **500 psig at 200 deg F (3450 kPa at 93 deg C)**.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.9 TEST-PLUG KITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. National Meter, Inc.
 4. Peterson Equipment Co., Inc.
 5. Sisco Manufacturing Company, Inc.
 6. Trerice, H. O. Co.
 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 8. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing one or two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with **1- to 2-inch- (25- to 51-mm-)** diameter dial and tapered-end sensing element. Dial range shall be at least **25 to 125 deg F (minus 4 to plus 52 deg C)**.
- D. High-Range Thermometer: Small, bimetallic insertion type with **1- to 2-inch- (25- to 51-mm-)** diameter dial and tapered-end sensing element. Dial range shall be at least **0 to 220 deg F (minus 18 to plus 104 deg C)**.
- E. Pressure Gage: Small, Bourdon-tube insertion type with **2- to 3-inch- (51- to 76-mm-)** diameter dial and probe. Dial range shall be at least **0 to 200 psig (0 to 1380 kPa)**.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

2.10 SIGHT FLOW INDICATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Archon Industries, Inc.
 2. Dwyer Instruments, Inc.
 3. Emerson Process Management; Brooks Instrument.
 4. Ernst Co., John C., Inc.
 5. Ernst Flow Industries.
 6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
 7. OPW Engineered Systems; a Dover company.
 8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
- B. Description: Piping inline-installation device for visual verification of flow.
- C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

- D. Minimum Pressure Rating: **125 psig (860 kPa)** or **150 psig (1034 kPa)**.
- E. Minimum Temperature Rating: **200 deg F (93 deg C)**.
- F. End Connections for **NPS 2 (DN 50)** and Smaller: Threaded.
- G. End Connections for **NPS 2-1/2 (DN 65)** and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of **2 inches (51 mm)** into fluid one-third of pipe diameter to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
 - 4. Inlet and outlet of each remote domestic water chiller.
- L. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Liquid-filled, Sealed, bimetallic-actuated type.
 - 2. Direct or Remote-mounted, metal or plastic-case, vapor-actuated type.
 - 3. Compact or Industrial-style, liquid-in-glass type.
 - 4. Direct or Remote-mounted, light-activated type.
 - 5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
 - 1. Liquid-filled or Sealed, bimetallic-actuated type.
 - 2. Direct or Remote-mounted, metal or plastic-case, vapor-actuated type.
 - 3. Compact or Industrial-style, liquid-in-glass type.
 - 4. Direct or Remote-mounted, light-activated type.
 - 5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
 - 1. Liquid-filled or Sealed, bimetallic-actuated type.
 - 2. Direct or Remote-mounted, metal or plastic-case, vapor-actuated type.
 - 3. Compact or Industrial-style, liquid-in-glass type.
 - 4. Direct or Remote-mounted, light-activated type.
 - 5. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- D. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:
 - 1. Liquid-filled or Sealed, bimetallic-actuated type.
 - 2. Direct or Remote-mounted, metal or plastic-case, vapor-actuated type.
 - 3. Compact or Industrial-style, liquid-in-glass type.
 - 4. Direct or Remote-mounted, light-activated type.
 - 5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.
- E. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: **0 to 100 deg F (Minus 20 to plus 50 deg C)** 0 to 100 deg F and minus 20 to plus 50 deg C.
- B. Scale Range for Domestic Cold-Water Piping: **0 to 150 deg F (Minus 20 to plus 70 deg C)** 0 to 150 deg F and minus 20 to plus 70 deg C.
- C. Scale Range for Domestic Cold-Water Piping: **30 to 240 deg F (0 to plus 115 deg C)** 30 to 240 deg F and 0 to plus 115 deg C.
- D. Scale Range for Domestic Hot-Water Piping: **0 to 250 deg F (0 to 150 deg C)** 0 to 250 deg F and 0 to 150 deg C.
- E. Scale Range for Domestic Hot-Water Piping: **20 to 240 deg F (0 to 150 deg C)** 20 to 240 deg F and 0 to 150 deg C.
- F. Scale Range for Domestic Hot-Water Piping: **30 to 240 deg F (0 to plus 115 deg C)** 30 to 240 deg F and 0 to plus 115 deg C.
- G. Scale Range for Domestic Cooled-Water Piping: **0 to 100 deg F (Minus 20 to plus 50 deg C)** 0 to 100 deg F and minus 20 to plus 50 deg C.
- H. Scale Range for Domestic Cooled-Water Piping: **0 to 150 deg F (Minus 20 to plus 70 deg C)** 0 to 150 deg F and minus 20 to plus 70 deg C.

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be one of the following:
 - 1. Liquid-filled, Sealed, Open-front, pressure-relief, Solid-front, pressure-relief, direct or remote-mounted, metal case.
 - 2. Sealed, direct or remote-mounted, plastic case.
 - 3. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
 - 1. Liquid-filled, Sealed, Open-front, pressure-relief, Solid-front, pressure-relief, direct or remote-mounted, metal case.
 - 2. Sealed, direct or remote-mounted, plastic case.
 - 3. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.
- C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
 - 1. Liquid-filled, Sealed, Open-front, pressure-relief, Solid-front, pressure-relief, direct or remote-mounted, metal case.
 - 2. Sealed, direct or remote-mounted, plastic case.
 - 3. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: **0 to 100 psi (0 to 600 kPa)** 0 to 100 psi and 0 to 600 kPa.
- B. Scale Range for Water Service Piping: **0 to 160 psi (0 to 1100 kPa)** 0 to 160 psi and 0 to 1100 kPa.
- C. Scale Range for Water Service Piping: **0 to 200 psi (0 to 1400 kPa)** 0 to 200 psi and 0 to 1400 kPa.
- D. Scale Range for Domestic Water Piping: **0 to 100 psi (0 to 600 kPa)** 0 to 100 psi and 0 to 600 kPa.
- E. Scale Range for Domestic Water Piping: **0 to 160 psi (0 to 1100 kPa)** 0 to 160 psi and 0 to 1100 kPa.
- F. Scale Range for Domestic Water Piping: **0 to 200 psi (0 to 1400 kPa)** 0 to 200 psi and 0 to 1400 kPa.
- G. Scale Range for Domestic Water Piping: **0 to 300 psi (0 to 2500 kPa)** 0 to 300 psi and 0 to 2500 kPa.

END OF SECTION 220519

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 220523 – GENERAL DUTY VALVES FOR
PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Iron ball valves.
5. Iron, single-flange butterfly valves.
6. Iron, grooved-end butterfly valves.
7. Bronze lift check valves.
8. Bronze swing check valves.
9. Iron swing check valves.
10. Iron swing check valves with closure control.
11. Iron, grooved-end swing check valves.
12. Iron, center-guided check valves.
13. Iron, plate-type check valves.
14. Bronze gate valves.
15. Iron gate valves.
16. Bronze globe valves.
17. Iron globe valves.
18. Lubricated plug valves.
19. Chainwheels.

B. Related Sections:

1. Section 02510 "Water Distribution" for valves applicable only to this piping.
2. Section 02620 "Subdrainage" for valves applicable only to this piping.
3. Section 02630 "Storm Drainage" for valves applicable only to this piping.
4. Section 15076 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
5. Section 15140 "Domestic Water Piping" for valves applicable only to this piping.
6. Section 15155 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
7. Section 15165 "Storm Drainage Piping Specialties" for valves applicable only to this piping.

8. Section 15214 "Compressed-Air Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.
9. Section 15216 "Gas Piping for Laboratory and Healthcare Facilities" for valves applicable only to this piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 2. ASME B31.1 for power piping valves.
 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set angle, gate, and globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.

- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves **NPS 8 (DN 200)** and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves **NPS 6 (DN 150)** and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With **2-inch (50-mm)** stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze or aluminum.

B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze or aluminum.

C. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kitz Corporation.
2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze or aluminum.

D. Class 150, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze or aluminum.

2.3 BRASS BALL VALVES

A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturer offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Kitz Corporation.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: One piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded.

- f. Seats: PTFE or TFE.
- g. Stem: Brass.
- h. Ball: Chrome-plated brass.
- i. Port: Reduced.

B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. DynaQuip Controls.
- d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
- e. Hammond Valve.
- f. Jamesbury; a subsidiary of Metso Automation.
- g. Jomar International, LTD.
- h. Kitz Corporation.
- i. Legend Valve.
- j. Marwin Valve; a division of Richards Industries.
- k. Milwaukee Valve Company.
- l. NIBCO INC.
- m. Red-White Valve Corporation.
- n. RuB Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

C. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
- d. Hammond Valve.
- e. Jamesbury; a subsidiary of Metso Automation.
- f. Kitz Corporation.

- g. [Marwin Valve; a division of Richards Industries.](#)
- h. [Milwaukee Valve Company.](#)
- i. [RuB Inc.](#)

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

D. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

- 1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Hammond Valve.](#)
- b. [Jamesbury; a subsidiary of Metso Automation.](#)
- c. [Legend Valve.](#)
- d. [Marwin Valve; a division of Richards Industries.](#)
- e. [Milwaukee Valve Company.](#)

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

E. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:

- 1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Jamesbury; a subsidiary of Metso Automation.](#)
- b. [Marwin Valve; a division of Richards Industries.](#)

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Brass or bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Regular.

F. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Jomar International, LTD.
- b. Kitz Corporation.
- c. Red-White Valve Corporation.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

G. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Jomar International, LTD.
- b. Kitz Corporation.
- c. Marwin Valve; a division of Richards Industries.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.

- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.4 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.

B. One-Piece, Reduced-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig (4140 kPa).
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.

- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Reduced.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [American Valve, Inc.](#)
- b. [Conbraco Industries, Inc.; Apollo Valves.](#)
- c. [Crane Co.; Crane Valve Group; Crane Valves.](#)
- d. [Hammond Valve.](#)
- e. [Lance Valves; a division of Advanced Thermal Systems, Inc.](#)
- f. [Legend Valve.](#)
- g. [Milwaukee Valve Company.](#)
- h. [NIBCO INC.](#)
- i. [Red-White Valve Corporation.](#)
- j. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

D. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Conbraco Industries, Inc.; Apollo Valves.](#)
- b. [Crane Co.; Crane Valve Group; Crane Valves.](#)
- c. [Hammond Valve.](#)
- d. [Lance Valves; a division of Advanced Thermal Systems, Inc.](#)
- e. [Milwaukee Valve Company.](#)
- f. [NIBCO INC.](#)
- g. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

E. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. DynaQuip Controls.
- f. Hammond Valve.
- g. Lance Valves; a division of Advanced Thermal Systems, Inc.
- h. Milwaukee Valve Company.
- i. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

F. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Regular.

G. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Conbraco Industries, Inc.: Apollo Valves.
- b. DynaQuip Controls.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Red-White Valve Corporation.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

H. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Conbraco Industries, Inc.: Apollo Valves.
- b. Hammond Valve.
- c. Milwaukee Valve Company.
- d. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.5 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Kitz Corporation.
 - d. Sure Flow Equipment Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-72.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Split body.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Ends: Flanged.
 - f. Seats: PTFE or TFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel.
 - i. Port: Full.

2.6 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.

- e. [Crane Co.; Crane Valve Group; Stockham Division.](#)
- f. [DeZurik Water Controls.](#)
- g. [Flo Fab Inc.](#)
- h. [Hammond Valve.](#)
- i. [Kitz Corporation.](#)
- j. [Legend Valve.](#)
- k. [Milwaukee Valve Company.](#)
- l. [NIBCO INC.](#)
- m. [Norriseal; a Dover Corporation company.](#)
- n. [Red-White Valve Corporation.](#)
- o. [Spence Strainers International; a division of CIRCOR International, Inc.](#)
- p. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)
- q.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: **200 psig (1380 kPa).**
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.](#)
- b. [Conbraco Industries, Inc.; Apollo Valves.](#)
- c. [Cooper Cameron Valves; a division of Cooper Cameron Corporation.](#)
- d. [Crane Co.; Crane Valve Group; Jenkins Valves.](#)
- e. [Crane Co.; Crane Valve Group; Stockham Division.](#)
- f. [DeZurik Water Controls.](#)
- g. [Flo Fab Inc.](#)
- h. [Hammond Valve.](#)
- i. [Kitz Corporation.](#)
- j. [Legend Valve.](#)
- k. [Milwaukee Valve Company.](#)
- l. [NIBCO INC.](#)
- m. [Norriseal; a Dover Corporation company.](#)
- n. [Red-White Valve Corporation.](#)
- o. [Spence Strainers International; a division of CIRCOR International, Inc.](#)
- p. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)

2. Description:

- a. Standard: MSS SP-67, Type I.

- b. CWP Rating: **200 psig (1380 kPa)**.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
- b. American Valve, Inc.
- c. Conbraco Industries, Inc.; Apollo Valves.
- d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
- e. Crane Co.; Crane Valve Group; Center Line.
- f. Crane Co.; Crane Valve Group; Stockham Division.
- g. DeZurik Water Controls.
- h. Flo Fab Inc.
- i. Hammond Valve.
- j. Kitz Corporation.
- k. Legend Valve.
- l. Milwaukee Valve Company.
- m. Mueller Steam Specialty; a division of SPX Corporation.
- n. NIBCO INC.
- o. Norriseal; a Dover Corporation company.
- p. Spence Strainers International; a division of CIRCOR International, Inc.
- q. Sure Flow Equipment Inc.
- r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: **200 psig (1380 kPa)**.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated[**or -coated**] ductile iron.

D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.

- b. [American Valve, Inc.](#)
- c. [Conbraco Industries, Inc.; Apollo Valves.](#)
- d. [Cooper Cameron Valves; a division of Cooper Cameron Corporation.](#)
- e. [Crane Co.; Crane Valve Group; Center Line.](#)
- f. [Crane Co.; Crane Valve Group; Stockham Division.](#)
- g. [DeZurik Water Controls.](#)
- h. [Flo Fab Inc.](#)
- i. [Hammond Valve.](#)
- j. [Kitz Corporation.](#)
- k. [Legend Valve.](#)
- l. [Milwaukee Valve Company.](#)
- m. [Mueller Steam Specialty; a division of SPX Corporation.](#)
- n. [NIBCO INC.](#)
- o. [Norriseal; a Dover Corporation company.](#)
- p. [Spence Strainers International; a division of CIRCOR International, Inc.](#)
- q. [Sure Flow Equipment Inc.](#)
- r. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated or coated ductile iron.

E. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.](#)
- b. [American Valve, Inc.](#)
- c. [Conbraco Industries, Inc.; Apollo Valves.](#)
- d. [Cooper Cameron Valves; a division of Cooper Cameron Corporation.](#)
- e. [Crane Co.; Crane Valve Group; Jenkins Valves.](#)
- f. [Crane Co.; Crane Valve Group; Stockham Division.](#)
- g. [DeZurik Water Controls.](#)
- h. [Flo Fab Inc.](#)
- i. [Hammond Valve.](#)
- j. [Kitz Corporation.](#)
- k. [Legend Valve.](#)
- l. [Milwaukee Valve Company.](#)
- m. [Mueller Steam Specialty; a division of SPX Corporation.](#)
- n. [NIBCO INC.](#)
- o. [Norriseal; a Dover Corporation company.](#)
- p. [Red-White Valve Corporation.](#)

- q. [Spence Strainers International; a division of CIRCOR International, Inc.](#)
- r. [Sure Flow Equipment Inc.](#)
- s. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)
- t.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Stainless steel.

F. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [ABZ Valves and Controls; A div. of ABZ Manufacturing, Inc.](#)
- b. [American Valve, Inc.](#)
- c. [Conbraco Industries, Inc.; Apollo Valves.](#)
- d. [Cooper Cameron Valves; A div. of Cooper Cameron Corp.](#)
- e. [Crane Co.; Crane Valve Group; Jenkins Valves.](#)
- f. [Crane Co.; Crane Valve Group; Stockham Div.](#)
- g. [DeZurik Water Controls.](#)
- h. [Flo Fab Inc.](#)
- i. [Hammond Valve.](#)
- j. [Kitz Corporation.](#)
- k. [Legend Valve.](#)
- l. [Milwaukee Valve Company.](#)
- m. [Mueller Steam Specialty; a division of SPX Corporation.](#)
- n. [NIBCO INC.](#)
- o. [Norriseal; a Dover Corporation company.](#)
- p. [Red-White Valve Corporation.](#)
- q. [Spence Strainers International; a division of CIRCOR International, Inc.](#)
- r. [Sure Flow Equipment Inc.](#)
- s. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.

- g. Disc: Stainless steel.

2.7 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Kennedy Valve; a division of McWane, Inc.](#)
 - b. [Shurjoint Piping Products.](#)
 - c. [Tyco Fire Products LP; Grinnell Mechanical Products.](#)
 - d. [Victaulic Company.](#)
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: **175 psig (1200 kPa).**
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Anvil International, Inc.](#)
 - b. [Kennedy Valve; a division of McWane, Inc.](#)
 - c. [Mueller Steam Specialty; a division of SPX Corporation.](#)
 - d. [NIBCO INC.](#)
 - e. [Shurjoint Piping Products.](#)
 - f. [Tyco Fire Products LP; Grinnell Mechanical Products.](#)
 - g. [Victaulic Company.](#)
 - h.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. **NPS 8 (DN 200) and Smaller CWP Rating: 300 psig (2070 kPa).**
 - c. **NPS 10 (DN 250) and Larger CWP Rating: 200 psig (1380 kPa).**
 - d. Body Material: Coated, ductile iron.
 - e. Stem: Two-piece stainless steel.
 - f. Disc: Coated, ductile iron.
 - g. Seal: EPDM.

2.8 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: **200 psig** (1380 kPa).
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Flo Fab Inc.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. Mueller Steam Specialty; a division of SPX Corporation.
 - f. NIBCO INC.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: **200 psig** (1380 kPa).
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: NBR, PTFE, or TFE.

2.9 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- l. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. [American Valve, Inc.](#)
 - b. [Crane Co.; Crane Valve Group; Crane Valves.](#)
 - c. [Crane Co.; Crane Valve Group; Jenkins Valves.](#)
 - d. [Crane Co.; Crane Valve Group; Stockham Division.](#)
 - e. [Kitz Corporation.](#)
 - f. [Milwaukee Valve Company.](#)
 - g. [NIBCO INC.](#)
 - h. [Red-White Valve Corporation.](#)
 - i. [Zy-Tech Global Industries, Inc.](#)
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Crane Co.; Crane Valve Group; Crane Valves.](#)
 - b. [Crane Co.; Crane Valve Group; Jenkins Valves.](#)
 - c. [Hammond Valve.](#)
 - d. [Milwaukee Valve Company.](#)
 - e. [NIBCO INC.](#)
 - f. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)
2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.10 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Legend Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.
- k. Sure Flow Equipment Inc.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Composition.
- g. Seat Ring: Bronze.
- h. Disc Holder: Bronze.
- i. Disc: PTFE or TFE.
- j. Gasket: Asbestos free.

C. Class 250, Iron Swing Check Valves with Metal Seats:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.11 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. **Manufacturers:** Subject to compliance with requirements, provide products by the following available manufacturer offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and spring.

B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Crane Co.; Crane Valve Group; Crane Valves.Crane Co.; Crane Valve Group; Jenkins Valves.](#)
- b. [Crane Co.; Crane Valve Group; Stockham Division.](#)
- c. [Hammond Valve.](#)
- d. [Milwaukee Valve Company.](#)
- e. [NIBCO INC.](#)
- f. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)

2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Ends: Flanged.
- f. Trim: Bronze.
- g. Gasket: Asbestos free.
- h. Closure Control: Factory-installed, exterior lever and weight.

2.12 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

- 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Anvil International, Inc.](#)
- b. [Shurjoint Piping Products.](#)
- c. [Tyco Fire Products LP; Grinnell Mechanical Products.](#)
- d. [Victaulic Company.](#)

2. Description:

- a. CWP Rating: 300 psig (2070 kPa).
- b. Body Material: ASTM A 536, ductile iron.
- c. Seal: EPDM.
- d. Disc: Spring-operated, ductile iron or stainless steel.

2.13 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

- 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Anvil International, Inc.](#)
- b. [APCO Willamette Valve and Primer Corporation.](#)

- c. [Crispin Valve.](#)
- d. [DFT Inc.](#)
- e. [Flo Fab Inc.](#)
- f. [GA Industries, Inc.](#)
- g. [Hammond Valve.](#)
- h. [Metraflex, Inc.](#)
- i. [Milwaukee Valve Company.](#)
- j. [Mueller Steam Specialty; a division of SPX Corporation.](#)
- k. [NIBCO INC.](#)
- l. [Spence Strainers International; a division of CIRCOR International, Inc.](#)
- m. [Sure Flow Equipment Inc.](#)
- n. [Val-Matic Valve & Manufacturing Corp.](#)
- o. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer.
- e. Seat: Bronze.

B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [APCO Willamette Valve and Primer Corporation.](#)
- b. [Crispin Valve.](#)
- c. [DFT Inc.](#)
- d. [Flomatic Corporation.](#)
- e. [Hammond Valve.](#)
- f. [Metraflex, Inc.](#)
- g. [Milwaukee Valve Company.](#)
- h. [Mueller Steam Specialty; a division of SPX Corporation.](#)
- i. [NIBCO INC.](#)
- j. [Spence Strainers International; a division of CIRCOR International, Inc.](#)
- k. [Sure Flow Equipment Inc.](#)
- l. [Val-Matic Valve & Manufacturing Corp.](#)
- m. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: Bronze.

C. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer.
 - e. Seat: Bronze.

D. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
 - d.
2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.

E. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Metraflex, Inc.
 - g. Milwaukee Valve Company.

- h. [NIBCO INC.](#)
- i. [Sure Flow Equipment Inc.](#)
- j. [Val-Matic Valve & Manufacturing Corp.](#)

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer, spring loaded.
- e. Seat: Bronze.

F. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [APCO Willamette Valve and Primer Corporation.](#)
- b. [Crispin Valve.](#)
- c. [DFT Inc.](#)
- d. [Flomatic Corporation.](#)
- e. [Hammond Valve.](#)
- f. [Metraflex, Inc.](#)
- g. [Milwaukee Valve Company.](#)
- h. [Mueller Steam Specialty; a division of SPX Corporation.](#)
- i. [NIBCO INC.](#)
- j. [Val-Matic Valve & Manufacturing Corp.](#)

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: Bronze.

G. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [APCO Willamette Valve and Primer Corporation.](#)
- b. [Crispin Valve.](#)
- c. [Val-Matic Valve & Manufacturing Corp.](#)

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: **500 psig** (3450 kPa).
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Compact wafer, spring loaded.
- e. Seat: Bronze.

H. Class 300, Iron, Globe, Center-Guided Check Valves with Metal Seat:

- 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
- 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: **500 psig** (3450 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: Bronze.

I. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

- 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. DFT Inc.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Spence Strainers International; a division of CIRCOR International, Inc.
 - i. Sure Flow Equipment Inc.
 - j. Val-Matic Valve & Manufacturing Corp.
- 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: **200 psig** (1380 kPa).
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Compact wafer.
 - e. Seat: EPDM or NBR.

J. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Anvil International, Inc.](#)
- b. [APCO Willamette Valve and Primer Corporation.](#)
- c. [Crispin Valve.](#)
- d. [DFT Inc.](#)
- e. [GA Industries, Inc.](#)
- f. [Hammond Valve.](#)
- g. [Milwaukee Valve Company.](#)
- h. [NIBCO INC.](#)
- i. [Sure Flow Equipment Inc.](#)
- j. [Val-Matic Valve & Manufacturing Corp.](#)

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: EPDM or NBR.

K. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [APCO Willamette Valve and Primer Corporation.](#)
- b. [Crispin Valve.](#)
- c. [Val-Matic Valve & Manufacturing Corp.](#)

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Compact wafer.
- e. Seat: EPDM or NBR.

L. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [APCO Willamette Valve and Primer Corporation.](#)
- b. [Crispin Valve.](#)
- c. [DFT Inc.](#)

d. [Val-Matic Valve & Manufacturing Corp.](#)

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: EPDM or NBR.

M. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [APCO Willamette Valve and Primer Corporation.](#)
- b. [Crispin Valve.](#)
- c. [DFT Inc.](#)
- d. [Flo Fab Inc.](#)
- e. [Hammond Valve.](#)
- f. [Milwaukee Valve Company.](#)
- g. [NIBCO INC.](#)
- h. [Sure Flow Equipment Inc.](#)
- i. [Val-Matic Valve & Manufacturing Corp.](#)

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Compact wafer, spring loaded.
- e. Seat: EPDM or NBR.

N. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [APCO Willamette Valve and Primer Corporation.](#)
- b. [Crispin Valve.](#)
- c. [DFT Inc.](#)
- d. [Hammond Valve.](#)
- e. [Milwaukee Valve Company.](#)
- f. [NIBCO INC.](#)
- g. [Val-Matic Valve & Manufacturing Corp.](#)

2. Description:

- a. Standard: MSS SP-125.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Material: ASTM A 126, gray iron.
- d. Style: Globe, spring loaded.
- e. Ends: Flanged.
- f. Seat: EPDM or NBR.

O. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer, spring loaded.
 - e. Seat: EPDM or NBR.

P. Class 300, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crispin Valve.
 - c. Val-Matic Valve & Manufacturing Corp.
2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM or NBR.

2.14 IRON, PLATE-TYPE CHECK VALVES

A. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. [APCO Willamette Valve and Primer Corporation.](#)
 - b. [Crane Co.; Crane Valve Group; Crane Valves.](#)
 - c. [Flomatic Corporation.](#)
 - d. [Mueller Steam Specialty; a division of SPX Corporation.](#)
 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: Bronze.
- B. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. [APCO Willamette Valve and Primer Corporation.](#)
 - b. [Crane Co.; Crane Valve Group; Crane Valves.](#)
 - c. [Mueller Steam Specialty; a division of SPX Corporation.](#)
 - d. [Val-Matic Valve & Manufacturing Corp.](#)
 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: Bronze.
- C. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. [APCO Willamette Valve and Primer Corporation.](#)
 - b. [Crane Co.; Crane Valve Group; Crane Valves.](#)
 2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 126, gray iron.

- e. Seat: Bronze.

D. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Mueller Steam Specialty; a division of SPX Corporation.
 - d. Val-Matic Valve & Manufacturing Corp.
2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Design: Wafer, spring-loaded plates.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Seat: Bronze.

E. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Flo Fab Inc.
 - b. Sure Flow Equipment Inc.
2. Description:
 - a. Standard: API 594.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Wafer, spring-loaded plate.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Seat: EPDM or NBR.

F. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. APCO Willamette Valve and Primer Corporation.
 - b. Cooper Cameron Valves TVB Techno.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. NIBCO INC.
 - f. Spence Strainers International; a division of CIRCOR International, Inc.
 - g. Sure Flow Equipment Inc.

h. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 126, gray iron.
- e. Seat: EPDM or NBR.

G. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [APCO Willamette Valve and Primer Corporation.](#)
- b. [Crane Co.; Crane Valve Group; Crane Valves.](#)
- c. [Crane Co.; Crane Valve Group; Jenkins Valves.](#)
- d. [Val-Matic Valve & Manufacturing Corp.](#)

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- e. Seat: EPDM or NBR.

H. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:

1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Sure Flow Equipment Inc.](#)

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Design: Wafer, spring-loaded plate.
- d. Body Material: ASTM A 126, gray iron.
- e. Seat: EPDM or NBR.

I. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:

1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [APCO Willamette Valve and Primer Corporation.](#)
- b. [Crane Co.; Crane Valve Group; Crane Valves.](#)
- c. [Sure Flow Equipment Inc.](#)

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 400 psig (2760 kPa).
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 126, gray iron.
- e. Seat: EPDM or NBR.

J. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [APCO Willamette Valve and Primer Corporation.](#)
- b. [Val-Matic Valve & Manufacturing Corp.](#)

2. Description:

- a. Standard: API 594.
- b. CWP Rating: 500 psig (3450 kPa).
- c. Body Design: Wafer, spring-loaded plates.
- d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
- e. Seat: EPDM or NBR.

2.15 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [American Valve, Inc.](#)
- b. [Crane Co.; Crane Valve Group; Crane Valves.](#)
- c. [Crane Co.; Crane Valve Group; Jenkins Valves.](#)
- d. [Crane Co.; Crane Valve Group; Stockham Division.](#)
- e. [Hammond Valve.](#)
- f. [Kitz Corporation.](#)
- g. [Milwaukee Valve Company.](#)
- h. [NIBCO INC.](#)
- i. [Powell Valves.](#)
- j. [Red-White Valve Corporation.](#)
- k. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)
- l. [Zy-Tech Global Industries, Inc.](#)

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze or aluminum.

B. Class 125, RS Bronze Gate Valves:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- k. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, NRS Bronze Gate Valves:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Hammond Valve.
- b. Kitz Corporation.
- c. Milwaukee Valve Company.
- d. NIBCO INC.
- e. Powell Valves.

- f. [Red-White Valve Corporation.](#)
- g. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

D. Class 150, RS Bronze Gate Valves:

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Crane Co.; Crane Valve Group; Crane Valves.](#)
- b. [Crane Co.; Crane Valve Group; Stockham Division.](#)
- c. [Hammond Valve.](#)
- d. [Kitz Corporation.](#)
- e. [Milwaukee Valve Company.](#)
- f. [NIBCO INC.](#)
- g. [Powell Valves.](#)
- h. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)
- i. [Zy-Tech Global Industries, Inc.](#)

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

2.16 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Crane Co.; Crane Valve Group; Crane Valves.](#)

- b. [Crane Co.; Crane Valve Group; Jenkins Valves.](#)
- c. [Crane Co.; Crane Valve Group; Stockham Division.](#)
- d. [Flo Fab Inc.](#)
- e. [Hammond Valve.](#)
- f. [Kitz Corporation.](#)
- g. [Legend Valve.](#)
- h. [Milwaukee Valve Company.](#)
- i. [NIBCO INC.](#)
- j. [Powell Valves.](#)
- k. [Red-White Valve Corporation.](#)
- l. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)
- m. [Zy-Tech Global Industries, Inc.](#)

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. [Crane Co.; Crane Valve Group; Crane Valves.](#)
- b. [Crane Co.; Crane Valve Group; Jenkins Valves.](#)
- c. [Crane Co.; Crane Valve Group; Stockham Division.](#)
- d. [Flo Fab Inc.](#)
- e. [Hammond Valve.](#)
- f. [Kitz Corporation.](#)
- g. [Legend Valve.](#)
- h. [Milwaukee Valve Company.](#)
- i. [NIBCO INC.](#)
- j. [Powell Valves.](#)
- k. [Red-White Valve Corporation.](#)
- l. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)
- m. [Zy-Tech Global Industries, Inc.](#)

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.

- g. Packing and Gasket: Asbestos free.

C. Class 250, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: **500 psig** (3450 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

D. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: **500 psig** (3450 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.17 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Hammond Valve.
- d. Kitz Corporation.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Powell Valves.
- h. Red-White Valve Corporation.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- j. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: **200 psig (1380 kPa).**
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. NIBCO INC.
- d. Red-White Valve Corporation.

2. Description:

- a. Standard: MSS SP-80, Type 2.
- b. CWP Rating: **200 psig (1380 kPa).**
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Hammond Valve.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Powell Valves.
 - g. Red-White Valve Corporation.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - i. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze or aluminum.

2.18 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.

- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.19 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. **Manufacturers:** Subject to compliance with requirements, provide product by the following available manufacturer offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Nordstrom Valves, Inc.

2. Description:

- a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

- a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

- a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.

- e. Plug: Cast iron or bronze with sealant groove.
- E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturer offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 400 psig (2760 kPa).

- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short Venturi.
- e. Plug: Cast iron or bronze with sealant groove.

H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

2.20 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 1. Babbitt Steam Specialty Co.
 2. Roto Hammer Industries.
 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to ball, butterfly and plug valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron, Ductile or cast iron, Aluminum, Bronze, of type and size required for valve. Include zinc coating.
 4. Chain: Hot-dip, galvanized steel, Brass, Stainless steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball, butterfly, gate, globe and plug valves **NPS 4 (DN 100)** and larger and more than **96 inches (2400 mm)** above floor. Extend chains to **60 inches (1520 mm)** above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
1. Shutoff Service: Ball, butterfly, gate or plug valves.
 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 3. Throttling Service: Globe, angle, ball or butterfly valves.
 4. Pump-Discharge Check Valves:
 - a. **NPS 2 (DN 50)** and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. **NPS 2-1/2 (DN 65)** and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
 - c. **NPS 2-1/2 (DN 65)** and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, **NPS 2 (DN 50)** and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Copper Tubing, **NPS 5 (DN 125)** and Larger: Flanged ends.
 4. For Steel Piping, **NPS 2 (DN 50)** and Smaller: Threaded ends.
 5. For Steel Piping, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 6. For Steel Piping, **NPS 5 (DN 125)** and Larger: Flanged ends.
 7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (**150 PSIG (1035 kPa)** OR LESS)

- A. Pipe **NPS 2 (DN 50)** and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: One, two and three piece, full, regular, reduced port, brass or bronze with brass, bronze or stainless-steel trim.
 3. Bronze Lift Check Valves: Class 125, bronze nonmetallic disc.
 4. Bronze Swing Check Valves: Class 125, Class 150], bronze, nonmetallic disc.
 5. Bronze Gate Valves: Class 125, Class 150, NRS, RS.
- B. Pipe **NPS 2-1/2 (DN 65)** and Larger:
1. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.

2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
3. Iron, Grooved-End Butterfly Valves: 175, 300 CWP.
4. Iron Swing Check Valves: Class 125, Class 250, metal, non-metallic-to-metal seats.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron, Center-Guided Check Valves: Class 125, Class 150, Class 250, Class 300, compact-wafer, globe, metal resilient seat.
7. Iron, Plate-Type Check Valves: Class 125, Class 150, Class 250, Class 300; single or dual plate; metal resilient seat.
8. Iron Gate Valves: Class 125, Class 250, NRS or OS&Y.

3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG (1035 TO 1380 kPa))

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One, two and three piece, full, regular or reduced port, brass or bronze with brass, bronze or stainless-steel trim.
3. Bronze Lift Check Valves: Class 125, bronze, nonmetallic disc.
4. Bronze Swing Check Valves: Class 125, Class 150, bronze or nonmetallic disc.
5. Bronze Gate Valves: Class 125, Class 150, NRS or RS.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
3. Iron, Grooved-End Butterfly Valves: 175 or 300 CWP.
4. Iron Swing Check Valves: Class 125, Class 250, metal or nonmetallic-to-metal seats.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron, Center-Guided Check Valves: Class 125, Class 150, Class 250 or Class 300, compact-wafer globe, metal resilient seat.
7. Iron, Plate-Type Check Valves: Class 125, Class 150, Class 250 or Class 300; single or dual plate; metal resilient seat.
8. Iron Gate Valves: Class 125, Class 250, NRS or OS&Y.

3.7 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, Class 150, bronze, nonmetallic disc.
3. Ball Valves: One, two or three piece, full, regular or reduced port, brass or bronze with brass, bronze or stainless steel trim.
4. Bronze Swing Check Valves: Class 125 Class 150, bronze or nonmetallic disc.

5. Bronze Gate Valves: Class 125, Class 150, NRS or RS.
6. Bronze Globe Valves: Class 125, Class 150, bronze or nonmetallic disc.

B. Pipe **NPS 2-1/2 (DN 65)** and Larger:

1. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM or NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
4. Iron, Grooved-End Butterfly Valves: 175 or 300 CWP.
5. Iron Swing Check Valves: Class 125, Class 250, metal or nonmetallic-to-metal seats.
6. Iron Swing Check Valves with Closure Control: Class 125, lever and spring weight.
7. Iron, Grooved-End Swing Check Valves: 300 CWP.
8. Iron, Center-Guided Check Valves: Class 125, Class 150, Class 250 or Class 300, compact-wafer globe, metal resilient seat.
9. Iron, Plate-Type Check Valves: Class 125, Class 150, Class 250 or Class 300; single or dual plate; metal resilient seat.
10. Iron Gate Valves: Class 125 or Class 250, NRS or OS&Y.
11. Iron Globe Valves: Class 125 or Class 250.

3.8 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe **NPS 2 (DN 50)** and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 or Class 150, bronze, nonmetallic or stainless-steel disc.
3. Ball Valves: One, two or three piece, full, regular or reduced port, brass or bronze with brass, bronze or stainless-steel trim.
4. Bronze Swing Check Valves: Class 125 or Class 150, bronze or nonmetallic disc.
5. Bronze Gate Valves: Class 125 or Class 150, NRS or RS.
6. Bronze Globe Valves: Class 125 or Class 150, bronze or nonmetallic disc.

B. Pipe **NPS 2-1/2 (DN 65)** and Larger:

1. Iron Valves, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron Swing Check Valves: Class 125 or Class 250], metal or nonmetallic-to-metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring weight.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron Gate Valves: Class 125 or Class 250, NRS or OS&Y.
7. Iron Globe Valves: Class 125 or Class 250.
8. Lubricated Plug Valves: Class 125 or Class 250, regular gland, cylindrical, threaded or flanged.

END OF SECTION 220523

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 220529 – HANGERS AND SUPPORTS
FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

B. Related Sections:

1. Section 05500 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 15073 "Vibration and Seismic Controls for Plumbing Piping and Equipment" Section 15078 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.
3. Section 15123 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment [and obtain approval from authorities having jurisdiction].

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers 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. Detail fabrication and assembly of trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

- #### A.
- Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass, polyurethane or stainless steel.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.

2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
3. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
4. Standard: MFMA-4.
5. Channels: Continuous slotted steel channel with in-turned lips.
6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
8. Metallic Coating: Electroplated zinc, Hot-dipped galvanized, Mill galvanized, In-line, hot galvanized, Mechanically-deposited zinc.
9. Paint Coating: Vinyl, Vinyl alkyd, Epoxy, Polyester, Acrylic, Amine or Alkyd.
10. Plastic Coating: PVC, Polyurethane, Epoxy or Polyester.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.

3. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
4. Standard: Comply with MFMA-4.
5. Channels: Continuous slotted steel channel with in-turned lips.
6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
8. Coating: Zinc, Paint or PVC.

2.5 FIBERGLASS STRUT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Allied Tube & Conduit.
 2. Champion Fiberglass, Inc.
 3. Cooper B-Line, Inc.
 4. SEASAFE, INC.; a Gibraltar Industries Company.
- C. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.
 1. Channels: Continuous slotted fiberglass or other plastic channel with in-turned lips.
 2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of fiberglass or stainless steel.

2.6 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.

8. [Rilco Manufacturing Co., Inc.](#)
9. [Value Engineered Products, Inc.](#)

- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 2. Base: Plastic or Stainless steel.
 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.9 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.10 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.11 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Non-staining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 07720 "Roof Accessories" for curbs.
- I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2 (DN 65)**

and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- Q. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. **NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm)** long and **0.048 inch (1.22 mm)** thick.
 - b. **NPS 4 (DN 100): 12 inches (305 mm)** long and **0.06 inch (1.52 mm)** thick.
 - c. **NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm)** long and **0.06 inch (1.52 mm)** thick.
 - d. **NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm)** long and **0.075 inch (1.91 mm)** thick.
 - e. **NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm)** long and **0.105 inch (2.67 mm)** thick.
 - 5. Pipes **NPS 8 (DN 200)** and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to **1-1/2 inches (40 mm)**

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 a minimum dry film thickness of **2.0 mils (0.05 mm)**.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09911 "Exterior Painting." Section 09912 "Interior Painting." Section 09960 "High-Performance Coatings."

- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to **1050 deg F (566 deg C)**, pipes **NPS 4 to NPS 24 (DN 100 to DN 600)**, requiring up to **4 inches (100 mm)** of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36 (DN 20 to DN 900)**, requiring clamp flexibility and up to **4 inches (100 mm)** of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24 (DN 15 to DN 600)** if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4 (DN 15 to DN 100)**, to allow off-center closure for hanger installation before pipe erection.
 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes **NPS 3/4 to NPS 8 (DN 20 to DN 200)**.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.

8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes **NPS 3/8 to NPS 8 (DN 10 to DN 200)**.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes **NPS 3/8 to NPS 3 (DN 10 to DN 80)**.
 12. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36 (DN 65 to DN 900)** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30 (DN 25 to DN 750)**, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24 (DN 65 to DN 600)**, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42 (DN 50 to DN 1050)** if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24 (DN 50 to DN 600)** if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30 (DN 50 to DN 750)** if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24 (DN 24 to DN 600)**.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24 (DN 20 to DN 600)** if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to **6 inches (150 mm)** for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches (32 mm)**.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 220548 – VIBRATION AND
SEISMIC CONTROLS FOR
PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.
17. Adhesive anchor bolts.

B. Related Requirements:

1. Section 15072 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 15074 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

- C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

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 vibration isolation device and seismic-restraint component required.
 - 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 member of ICC-ES OSHPD an 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. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. 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 was examined for excessive stress and that none exists.
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. 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 Sections for equipment mounted outdoors.

- d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 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 Qualifications: 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 unavailable, 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: A, B, C, D, E, F
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I, II, III.
 - a. Component Importance Factor: 1.0, 1.5.

- b. Component Response Modification Factor: 1.5, 2.5, 3.5, 5.0
- c. Component Amplification Factor: 1.0, 2.5.
- 3. Design Spectral Response Acceleration at Short Periods (0.2 Second).
- 4. Design Spectral Response Acceleration at 1.0-Second Period.
- 5. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction.
 - a. 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 are subjected.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
- 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
- 3. Size: Factory or field cut to match requirements of supported equipment.
- 4. Pad Material: Oil and water resistant with elastomeric properties.
- 5. Surface Pattern: Smooth, Ribbed or Waffle pattern.
- 6. Infused nonwoven cotton or synthetic fibers.
- 7. Load-bearing metal plates adhered to pads.
- 8. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth, Ribbed or Waffle pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.

- c. [Isolation Technology, Inc.](#)
- d. [Kinetics Noise Control, Inc.](#)
- e. [Mason Industries, Inc.](#)
- f. [Vibration Eliminator Co., Inc.](#)
- g. [Vibration Isolation.](#)
- h. [Vibration Mountings & Controls, Inc.](#)

2. Mounting Plates:

- a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
- b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

- 1. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
- 2. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

- 1. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
- 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. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to **500 psig (3447 kPa)**.
 - 7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
 - 1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
 - 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. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psig (3447 kPa)**.
 - b. Top housing with attachment and leveling bolt threaded mounting holes and internal leveling device elastomeric pad.

2.7 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psig (3447 kPa)**.
 - b. Top plate with threaded mounting holes, elastomeric pad.
 - c. Internal leveling bolt that acts as blocking during installation.
3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psig (3447 kPa)**.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
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.

2.9 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum **1/2-inch- (13-mm-)** thick neoprene.
 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: **500 psig (3.45 MPa)** on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum **1/2-inch- (13-mm-)** thick neoprene.
 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
 1. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)

- e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Mountings & Controls, Inc.](#)
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
 1. [Basis-of-Design Product](#): Subject to compliance with requirements, provide comparable product by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Kinetics Noise Control, Inc.](#)
 - d. [Mason Industries, Inc.](#)
 - e. [Vibration Eliminator Co., Inc.](#)
 - f. [Vibration Isolation.](#)
 - g. [Vibration Mountings & Controls, Inc.](#)
 2. 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.
 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. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.13 SNUBBERS

- A. [Basis-of-Design Product](#): Subject to compliance with requirements, provide comparable product by one of the following:
 1. [Kinetics Noise Control, Inc.](#)

2. [Mason Industries, Inc.](#)
3. [Vibration Mountings & Controls, Inc.](#)

B. Description: 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.

2.14 RESTRAINT CHANNEL BRACINGS

A. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide comparable product by one of the following:

1. [Cooper B-Line, Inc.](#)
2. [Hilti, Inc.](#)
3. [Mason Industries, Inc.](#)
4. [Unistrut.](#)

B. Description: MFMA-4, shop- or field-fabricated bracing 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; rated in tension, compression, and torsion forces.

2.15 RESTRAINT CABLES

A. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide comparable product by one of the following:

1. [Kinetics Noise Control, Inc.](#)
2. [Loos & Co., Inc.](#)
3. [Vibration Mountings & Controls, Inc.](#)

B. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.16 SEISMIC-RESTRAINT ACCESSORIES

A. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide comparable product by one of the following:

1. [Cooper B-Line, Inc.](#)
2. [Kinetics Noise Control, Inc.](#)

3. [Mason Industries, Inc.](#)
4. [TOLCO.](#)

- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. 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.
- E. 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.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.17 MECHANICAL ANCHOR BOLTS

- A. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide comparable product by one of the following:
 1. [Cooper B-Line, Inc.](#)
 2. [Hilti, Inc.](#)
 3. [Kinetics Noise Control, Inc.](#)
 4. [Mason Industries, Inc.](#)
- B. 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.

2.18 ADHESIVE ANCHOR BOLTS

- A. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide comparable product by one of the following:
 1. [Hilti, Inc.](#)
 2. [Kinetics Noise Control, Inc.](#)
 3. [Mason Industries, Inc.](#)
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC 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.

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 of the Work.
- 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 Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES, OSHPD or 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 is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03300 "Cast-in-Place Concrete." And Section 03305 "Miscellaneous Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 07720 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
 - 1. Install seismic snubbers on plumbing 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 member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Piping Restraints:
1. Comply with requirements in MSS SP-127.
 2. Space lateral supports a maximum of **40 feet (12 m)** o.c., and longitudinal supports a maximum of **80 feet (24 m)** o.c.
 3. Brace a change of direction longer than **12 feet (3.7 m)**.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. 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.
- J. 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.
- K. 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 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 Section 15140 "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- 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 post-connection 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.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

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.

END OF SECTION 220548

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 22054813 – VIBRATION
CONTROLS FOR PLUMBING
PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.

B. Related Requirements:

1. Section 15068 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.
2. Section 15071 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 vibration isolation device type required.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Delegated-Design Submittal: For each vibration isolation device.
 1. Include design calculations for selecting vibration isolators.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.
- C. Welding certificates.
- D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
 3. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.

4. Size: Factory or field cut to match requirements of supported equipment.
5. Pad Material: Oil and water resistant with elastomeric properties.
6. Surface Pattern: Smooth, ribbed or waffle pattern.
7. Infused nonwoven cotton or synthetic fibers.
8. Load-bearing metal plates adhered to pads.
9. Sandwich-Core Material: Resilient and elastomeric
 - a. Surface Pattern: Smooth, ribbed or waffle pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
3. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
4. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
3. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
- a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
- 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. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to **500 psig (3447 kPa)**.
- 8. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.
 - h. Vibration Mountings & Controls, Inc.
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. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
 - b. Top housing with attachment and leveling bolt, threaded mounting holes and internal leveling device or elastomeric pad.

2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Isolation Technology, Inc.
 - d. Kinetics Noise Control, Inc.
 - e. Mason Industries, Inc.
 - f. Vibration Eliminator Co., Inc.
 - g. Vibration Isolation.

- h. [Vibration Mountings & Controls, Inc.](#)
- 3. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psig (3447 kPa)**.
 - b. Top plate with threaded mounting holes or elastomeric pad.
 - c. Internal leveling bolt that acts as blocking during installation.
- 4. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
- 5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
- 3. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to **500 psig (3447 kPa)**.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
- 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum ~~1/2-inch-~~ (13-mm-) thick neoprene
 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 2. Maximum Load Per Support: 500 psig (3.45 MPa) on isolation material providing equal isolation in all directions.

2.9 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum ~~1/2-inch-~~ (13-mm-) thick neoprene
 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.10 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Mountings & Controls, Inc.](#)
 3. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 4. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.11 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. California Dynamics Corporation.
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Eliminator Co., Inc.
 - f. Vibration Isolation.
 - g. Vibration Mountings & Controls, Inc.
 - 3. 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.
 - 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 10. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 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 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03300 "Cast-in-Place Concrete." And Section 03305 "Miscellaneous Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 22054813

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 220553 – IDENTIFICATION FOR
PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm), Stainless steel, 0.025-inch (0.64-mm), Aluminum, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm), 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Red
3. Background Color: White
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/16 inch (1.6 mm)** or **1/8 inch (3.2 mm)** thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to **160 deg F (71 deg C)**.
- E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
- F. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least **1-1/2 inches (38 mm)** high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of **3/4 inch (19 mm)** for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum, Brass, Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with **1/4-inch (6.4-mm)** letters for piping system abbreviation and **1/2-inch (13-mm)** numbers.
 1. Tag Material: Brass, **0.032-inch (0.8-mm)**, Stainless steel **0.025-inch (0.64-mm)**, Aluminum, **0.032-inch (0.8-mm)** or anodized aluminum **0.032-inch (0.8-mm)** minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on **8-1/2-by-11-inch (A4)** bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: **3 by 5-1/4 inches (75 by 133 mm)** minimum Approximately **4 by 7 inches (100 by 178 mm)**
 2. Fasteners: Reinforced grommet and wire or string.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 09912 "Interior Painting." Section 09960 "High-Performance Coatings."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1 on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of **50 feet (15 m)** along each run. Reduce intervals to **25 feet (7.6 m)** in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
 - 1. Domestic Water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.
 - 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

- a. Cold Water: **1-1/2 inches (38 mm), 2 inches (50 mm)**], round.
- b. Hot Water: **1-1/2 inches (38 mm), 2 inches (50 mm)**], square.

2. Valve-Tag Color:

- a. Cold Water: Natural.
- b. Hot Water: Green

3. Letter Color:

- a. Cold Water: Black.
- b. Hot Water: White.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 220716 – PLUMBING
EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Related Sections:

- 1. Section 15085 "Plumbing Piping Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies 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: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail removable insulation at equipment connections and access panels.
 - 4. Detail application of field-applied jackets.
 - 5. Detail application at linkages of control devices.
 - 6. Detail field application for each equipment type.
- D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Sheet Form Insulation Materials: 12 inches (300 mm) square.

2. Sheet Jacket Materials: 12 inches (300 mm) square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
 1. Equipment Mockups: Sump pump
 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 4. Obtain Architect's approval of mockups before starting insulation application.
 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15061 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with equipment Installer for equipment insulation application.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Domestic Water Boiler Breeching Insulation Schedule" and "Equipment Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. **Products:** Subject to compliance with requirements, provide the following available product that may be incorporated into the work include, but are not limited to, the following:

- a. [Industrial Insulation Group \(IIG\): Thermo-12 Gold.](#)
- 2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. [Products:](#) Subject to compliance with requirements, provide the following available product that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Pittsburgh Corning Corporation; Foamglas.](#)
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. [Products:](#) Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Aeroflex USA, Inc.; Aerocel.](#)
 - b. [Armacell LLC; AP Armaflex.](#)
 - c. [K-Flex USA; Insul-Sheet and K-FLEX LS.](#)
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. [Products:](#) Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. [CertainTeed Corp.; SoftTouch Duct Wrap.](#)
 - b. [Johns Manville; Microlite.](#)
 - c. [Knauf Insulation; Friendly Feel Duct Wrap.](#)
 - d. [Manson Insulation Inc.; Alley Wrap.](#)
 - e. [Owens Corning; SOFTR All-Service Duct Wrap.](#)

- J. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
1. **Products:** Subject to compliance with requirements provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Industrial Insulation Group \(IIG\); MinWool-1200 Flexible Batt.](#)
 - b. [Johns Manville; HTB 26 Spin-Glas.](#)
 - c. [Roxul Inc.; Roxul RW.](#)
- K. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ or with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-applied Jackets" Article.
1. **Products:** Subject to compliance with requirements provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. [CertainTeed Corp.; CertaPro Commercial Board.](#)
 - b. [Fibrex Insulations Inc.; FBX.](#)
 - c. [Johns Manville; 800 Series Spin-Glas.](#)
 - d. [Knauf Insulation; Insulation Board.](#)
 - e. [Manson Insulation Inc.; AK Board.](#)
 - f. [Owens Corning; Fiberglas 700 Series.](#)
- L. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Fibrex Insulations Inc.; FBX.](#)
 - b. [Industrial Insulation Group \(IIG\); MinWool-1200 Industrial Board.](#)
 - c. [Rock Wool; Delta Board.](#)
 - d. [Roxul Inc.; RHT and RockBoard.](#)
 - e. [Thermafiber, Inc.; Thermafiber Industrial Felt.](#)
- M. Mineral-Fiber, Preformed Pipe Insulation:
1. **Products:** Subject to compliance with requirements provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Fibrex Insulations Inc.; Coreplus 1200.](#)
 - b. [Johns Manville; Micro-Lok.](#)
 - c. [Knauf Insulation; 1000-Degree Pipe Insulation.](#)
 - d. [Manson Insulation Inc.; Alley-K.](#)

- e. [Owens Corning; Fiberglas Pipe Insulation.](#)
 - 2. Type I, **850 Deg F (454 Deg C)** Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - N. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ or FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is **2.5 lb/cu. ft. (40 kg/cu. m)** or more. Thermal conductivity (k-value) at **100 deg F (55 deg C)** is **0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K)** or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. [Products:](#) Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [CertainTeed Corp.; CrimpWrap.](#)
 - b. [Johns Manville; MicroFlex.](#)
 - c. [Knauf Insulation; Pipe and Tank Insulation.](#)
 - d. [Manson Insulation Inc.; AK Flex.](#)
 - e. [Owens Corning; Fiberglas Pipe and Tank Insulation.](#)
 - O. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 - 1. [Products:](#) Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Armacell LLC; Tubolit.](#)
 - b. [Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.](#)
- 2.2 INSULATING CEMENTS
- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. [Products:](#) Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Ramco Insulation, Inc.; Super-Stik.](#)
 - B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:

- a. Ramco Insulation, Inc.; Thermokote V.

- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:

- a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of **50 to 800 deg F** (10 to 427 deg C).

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.

- b. Eagle Bridges - Marathon Industries; 290.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.

- d. Mon-Eco Industries, Inc.; 22-30.

- e. Vimasco Corporation; 760.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive 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."

- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of **minus 100 to plus 200 deg F** (minus 73 to plus 93 deg C).

1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 - b.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive 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."
- D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive 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."
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive 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."
- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - e.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

2.4 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 available products that may be incorporated into the work include, but are not limited to, the following:

- a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
 - b. Vimasco Corporation; 749.
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 available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges - Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 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 available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 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 available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
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.

2.5 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 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 available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over insulation.
 4. Service Temperature Range: **0 to plus 180 deg F** (Minus 18 to plus 82 deg C).
 5. Color: White.

2.6 SEALANTS

- A. Joint Sealants:
 1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.
 4. Service Temperature Range: **Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).**
 5. Color: White or gray.
 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. FSK and Metal Jacket Flashing Sealants:

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
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."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

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."

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: **4-mil- (0.10-mm-)** thick, white PVDC biaxially oriented barrier film with a permeance at **0.02 perm (0.013 metric perm)** when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC Jacket for Outdoor Applications: **6-mil- (0.15-mm-)** thick, white PVDC biaxially oriented barrier film with a permeance at **0.01 perm (0.007 metric perm)** when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

- a. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:

- 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately **6 oz./sq. yd. (203 g/sq. m)** with a thread count of **5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm)** for covering equipment.

- 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

- B. Woven Polyester Fabric: Approximately **1 oz./sq. yd. (34 g/sq. m)** with a thread count of **10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm)**, in a Leno weave, for equipment.

- 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of **8 oz./sq. yd. (271 g/sq. m)**.

- 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:

- a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color as selected by Architect.
4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **1-mil- (0.025-mm-)** thick, heat-bonded polyethylene and kraft paper **3-mil- (0.075-mm-)** thick or heat-bonded polyethylene and kraft paper **2.5-mil- (0.063-mm-)** thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: **3-mil- (0.075-mm-)** thick, heat-bonded polyethylene and kraft paper or **2.5-mil- (0.063-mm-)** thick polysurlyn.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: **1-mil- (0.025-mm-)** thick, heat-bonded polyethylene and kraft paper **3-mil- (0.075-mm-)** thick, heat-bonded polyethylene and kraft paper **2.5-mil- (0.063-mm-)** thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: **3-mil- (0.075-mm-)** thick, heat-bonded polyethylene and kraft paper **2.5-mil- (0.063-mm-)** thick polysurlyn.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 6.5 mils (0.16 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. **Products:** Subject to compliance with requirements, **provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:**
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.

6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape and Saran 560 Vapor Retarder Tape.
2. Width: 3 inches (75 mm).
3. Film Thickness: [4 mils (0.10 mm)] [6 mils (0.15 mm)].
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, [1/2 inch (13 mm)] [3/4 inch (19 mm)] wide with wing seal or closed seal.

3. Aluminum: [ASTM B 209](#) ([ASTM B 209M](#)), Alloy 3003, 3005, 3105, or 5005; Temper H-14, [0.020 inch](#) ([0.51 mm](#)) thick, [[1/2 inch](#) ([13 mm](#))] [[3/4 inch](#) ([19 mm](#))] wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [[0.106-inch](#) ([2.6-mm-](#))] [[0.135-inch](#) ([3.5-mm-](#))] diameter shank, length to suit depth of insulation indicated.
 - a. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - 1) [AGM Industries, Inc.; CWP-1.](#)
 - 2) [GEMCO; CD.](#)
 - 3) [Midwest Fasteners, Inc.; CD.](#)
 - 4) [Nelson Stud Welding; TPA, TPC, and TPS.](#)
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [[0.106-inch](#) ([2.6-mm-](#))] [[0.135-inch](#) ([3.5-mm-](#))] diameter shank, length to suit depth of insulation indicated with integral [1-1/2-inch](#) ([38-mm](#)) galvanized carbon-steel washer.
 - a. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - 1) [AGM Industries, Inc.; CHP-1.](#)
 - 2) [GEMCO; Cupped Head Weld Pin.](#)
 - 3) [Midwest Fasteners, Inc.; Cupped Head.](#)
 - 4) [Nelson Stud Welding; CHP.](#)
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - 1) [AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.](#)
 - 2) [GEMCO; Perforated Base.](#)
 - 3) [Midwest Fasteners, Inc.; Spindle.](#)
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, [0.030 inch](#) ([0.76 mm](#)) thick by [2 inches](#) ([50 mm](#)) square.

- c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum or Stainless steel, fully annealed, **0.106-inch- (2.6-mm-)** diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, **0.030 inch (0.76 mm)** thick by **1-1/2 inches (38 mm)** in diameter.
 - c. Spindle: Nylon, **0.106-inch- (2.6-mm-)** diameter shank, length to suit depth of insulation indicated, up to **2-1/2 inches (63 mm)**.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
 - a. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, **0.030 inch (0.76 mm)** thick by **2 inches (50 mm)** square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum or Stainless steel, fully annealed, **0.106-inch- (2.6-mm-)** diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
- 6. Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch- (0.41-mm-)** thick, galvanized-steel, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches (38 mm)** in diameter.

- a. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC 150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from **0.016-inch- (0.41-mm-)** thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches (38 mm)** in diameter.
- a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal **3/4-inch- (19-mm-)** wide, stainless steel or Monel.
- D. Wire: **0.080-inch (2.0-mm)** nickel-copper alloy, **0.062-inch (1.6-mm)** soft-annealed, stainless steel or **0.062-inch (1.6-mm)** soft-annealed, galvanized steel.
- 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. C & F Wire.

2.13 CORNER ANGLES

- A. PVC Corner Angles: **30 mils (0.8 mm)** thick, minimum **1 by 1 inch (25 by 25 mm)**, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: **0.040 inch (1.0 mm)** thick, minimum **1 by 1 inch (25 by 25 mm)**, aluminum according to **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: **0.024 inch (0.61 mm)** thick, minimum **1 by 1 inch (25 by 25 mm)**, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer **5 mils (0.127 mm)** thick and an epoxy finish **5 mils (0.127 mm)** thick if operating in a temperature range between **140 and 300 deg F (60 and 149 deg C)**. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between **32 and 300 deg F (0 and 149 deg C)** with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with **3-inch- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
 - 3. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [**2 inches (50 mm)**] [**4 inches (100 mm)**] o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Mineral-Fiber, Pipe, and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 or 50 percent coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 - 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft

cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of **48 inches (1200 mm)** o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least **3 inches (75 mm)**.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 or 50 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on **6-inch (150-mm)** centers, starting at corners. Install **3/8-inch- (10-mm-)** diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, aluminum or stainless steel, at least [**0.040 inch (1.0 mm)**] [**0.050 inch (1.3 mm)**] [**0.060 inch (1.6 mm)**] thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Domestic Water Boiler Breechings:

1. Secure single-layer insulation with stainless-steel bands at **12-inch (300-mm)** intervals and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least **3 inches (75 mm)**. Secure inner layer with wire spaced at **12-inch (300-mm)** intervals. Secure outer layer with stainless-steel bands at **12-inch (300-mm)** intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least **1 inch (25 mm)**. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with **2-inch (50-mm)** overlap at seams and joints.
 - 2. Embed glass cloth between two **0.062-inch- (1.6-mm-)** thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with **1-1/2-inch (38-mm)** laps at longitudinal seams and **3-inch- (75-mm-)** wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with **1-inch (25-mm)** overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with **2-inch (50-mm)** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches (300 mm)** o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
 - 1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of **33-1/2 inches (850 mm)** or less. **33-1/2-inch- (850-mm-)** circumference limit allows for **2-inch- (50-mm-)** overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 - 2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09911 "Exterior Painting" and Section 09912 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DOMESTIC WATER BOILER BREECHING INSULATION SCHEDULE

- A. Round, exposed breeching and connector insulation shall be one of the following:
 - 1. Calcium Silicate: 4 inches (100 mm) thick.
 - 2. High-Temperature Mineral-Fiber Blanket: 3 inches (75 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.
 - 3. High-Temperature Mineral-Fiber Board: 3 inches (75 mm) thick and [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
- B. Round, concealed breeching and connector insulation shall be one of the following:
 - 1. Calcium Silicate: 4 inches (100 mm) thick.

2. High-Temperature Mineral-Fiber Blanket: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m)** nominal density.
3. High-Temperature Mineral-Fiber Board: **3 inches (75 mm)** thick and [**3-lb/cu. ft. (48-kg/cu. m)**] [**6-lb/cu. ft. (96-kg/cu. m)**] nominal density.

C. Rectangular, exposed breeching and connector insulation shall be one of the following:

1. Calcium Silicate: **4 inches (100 mm)** thick.
2. High-Temperature Mineral-Fiber Blanket: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m)** nominal density.
3. High-Temperature Mineral-Fiber Board: **3 inches (75 mm)** thick and [**3-lb/cu. ft. (48-kg/cu. m)**] [**6-lb/cu. ft. (96-kg/cu. m)**] nominal density.

D. Rectangular, concealed breeching and connector insulation shall be one of the following:

1. Calcium Silicate: **4 inches (100 mm)** thick.
2. High-Temperature Mineral-Fiber Blanket: **3 inches (75 mm)** thick and **3-lb/cu. ft. (48-kg/cu. m)** nominal density.
3. High-Temperature Mineral-Fiber Board: **3 inches (75 mm)** thick and [**3-lb/cu. ft. (48-kg/cu. m)**] [**6-lb/cu. ft. (96-kg/cu. m)**] nominal density.

3.11 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment that is not factory insulated.

C. Heat-exchanger (water-to-water for domestic water heating service) insulation shall be[**one of**] the following:

1. Calcium Silicate: **3 inches (75 mm)** thick.
2. Cellular Glass: **3 inches (75 mm)** thick.
3. Mineral-Fiber Blanket: **2 inches (50 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
4. Mineral-Fiber Board: **2 inches (50 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)**] nominal density.
5. Mineral-Fiber Pipe and Tank: **2 inches (50 mm)** thick.
6. Mineral-Fiber Preformed Pipe Insulation, Type I: **2 inches (50 mm)** thick.

D. Steam-to-hot-water converter insulation shall be one of the following:

1. Calcium Silicate: **3 inches (75 mm)** thick.
2. Cellular Glass: **3 inches (75 mm)** thick.
3. Mineral-Fiber Blanket: **2 inches (50 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
4. Mineral-Fiber Board: **2 inches (50 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
5. Mineral-Fiber Pipe and Tank: **2 inches (50 mm)** thick.

6. Mineral-Fiber Preformed Pipe Insulation, Type I: **2 inches (50 mm)** thick.
- E. Domestic water pump insulation shall be one of the following:
1. Cellular Glass: **2 inches (50 mm)** thick.
 2. Mineral-Fiber Blanket: **1 inch (25 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
 3. Mineral-Fiber Board: **1 inch (25 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
- F. Domestic chilled-water (potable) pump insulation shall be **[one of]** the following:
1. Cellular Glass: **3 inches (75 mm)** thick.
 2. Mineral-Fiber Blanket: **2 inches (50 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
 3. Mineral-Fiber Board: **2 inches (50 mm)** thick and **[2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)]** nominal density.
- G. Domestic hot-water pump insulation shall be one of the following:
1. Cellular Glass: **2 inches (50 mm)** thick.
 2. Mineral-Fiber Blanket: **1 inch (25 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
 3. Mineral-Fiber Board: **1 inch (25 mm)** and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
- H. Domestic water, domestic chilled-water (potable), and domestic hot-water hydropneumatic tank insulation shall be one of the following:
1. Cellular Glass: **[1-1/2 inches (38 mm)]** thick.
 2. Flexible Elastomeric: **1 inch (25 mm)** thick.
 3. Mineral-Fiber Blanket: **1 inch (25 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
 4. Mineral-Fiber Board: **1 inch (25 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
 5. Mineral-Fiber Pipe and Tank: **1 inch (25 mm)** thick.
 6. Polyolefin: **1 inch (25 mm)** thick.
- I. Domestic hot-water storage tank insulation shall be one of the following, of thickness to provide an R-value of 12.5.
1. Cellular glass.
 2. Mineral-Fiber Blanket: **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)]** nominal density.
 3. Mineral-Fiber Board: **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)]** nominal density.
 4. Mineral-fiber pipe and tank.
- J. Domestic water storage tank insulation shall be one of the following:

1. Cellular Glass: **2 inches (50 mm)** thick.
2. Flexible Elastomeric: **1 inch (25 mm)** thick.
3. Mineral-Fiber Blanket: **1 inch (25 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
4. Mineral-Fiber Board: [**1 inch (25 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
5. Mineral-Fiber Pipe and Tank: **1 inch (25 mm)** thick.
6. Polyolefin: **1 inch (25 mm)** thick.

K. Domestic chilled-water (potable) storage tank insulation shall be one of the following:

1. Cellular Glass: **2 inches (50 mm)** thick.
2. Flexible Elastomeric: **1 inch (25 mm)** thick.
3. Mineral-Fiber Blanket: **1 inch (25 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
4. Mineral-Fiber Board: **1 inch (25 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
5. Mineral-Fiber Pipe and Tank: **1 inch (25 mm)** thick.
6. Polyolefin: **1 inch (25 mm)** thick.

L. Domestic water filter-housing insulation shall be one of the following:

1. Cellular Glass: **3 inches (75 mm)** thick.
2. Mineral-Fiber Blanket: **2 inches (50 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
3. Mineral-Fiber Board: **2 inches (50 mm)** thick and **2-lb/cu. ft. (32-kg/cu. m) 3-lb/cu. ft. (48-kg/cu. m) 6-lb/cu. ft. (96-kg/cu. m)** nominal density.
4. Mineral-Fiber Pipe and Tank: **2 inches (50 mm)** thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 1. None.
 2. **PVC, Color-Coded by System: 20 mils (0.5 mm) 30 mils (0.8 mm)** thick.
 3. **Aluminum, Smooth Corrugated Stucco Embossed: 0.016 inch (0.41 mm) 0.020 inch (0.51 mm) 0.024 inch (0.61 mm) 0.032 inch (0.81 mm) 0.040 inch (1.0 mm)** thick.
 4. **Painted Aluminum, Smooth Corrugated Stucco Embossed: 0.016 inch (0.41 mm) 0.020 inch (0.51 mm) 0.024 inch (0.61 mm) 0.032 inch (0.81 mm)** thick.
 5. **Stainless Steel, Type 304 or Type 316, Smooth 2B Finish Corrugated Stucco Embossed: 0.010 inch (0.25 mm) 0.016 inch (0.41 mm) 0.020 inch (0.51 mm) 0.024 inch (0.61 mm)** thick.

- D. Equipment, Exposed, up to **48 Inches** (1200 mm) in Diameter or with Flat Surfaces up to **72 Inches** (1800 mm):
1. None.
 2. PVC, Color-Coded by System: **20 mils** (0.5 mm) **30 mils** (0.8 mm) thick.
 3. Aluminum, Smooth Corrugated Stucco Embossed: **0.016 inch** (0.41 mm) **0.020 inch** (0.51 mm) **0.024 inch** (0.61 mm) **0.032 inch** (0.81 mm) **0.040 inch** (1.0 mm) thick.
 4. Painted Aluminum, Smooth Corrugated Stucco Embossed: **0.016 inch** (0.41 mm) **0.020 inch** (0.51 mm) **0.024 inch** (0.61 mm) **0.032 inch** (0.81 mm) thick.
 5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish Corrugated Stucco Embossed: **0.010 inch** (0.25 mm) **0.016 inch** (0.41 mm) **0.020 inch** (0.51 mm) **0.024 inch** (0.61 mm) thick.
- E. Equipment, Exposed, Larger Than **48 Inches** (1200 mm) in Diameter or with Flat Surfaces Larger Than **72 Inches** (1800 mm):
1. None.
 2. Painted Aluminum, Smooth Stucco Embossed with **1-1/4-Inch-** (32-mm-) Deep Corrugations **2-1/2-Inch-** (65-mm-) Deep Corrugations **4-by-1-Inch** (100-by-25-mm) Box Ribs: **0.032 inch** (0.81 mm) **0.040 inch** (1.0 mm) thick.
 3. Stainless Steel, Type 304 or Type 316, Smooth Stucco Embossed, with [**1-1/4-Inch-** (32-mm-) Deep Corrugations **2-1/2-Inch-** (65-mm-) Deep Corrugations **4-by-1-Inch** (100-by-25-mm) Box Ribs: **0.020 inch** (0.51 mm) **0.024 inch** (0.61 mm) thick.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
1. None.
 2. PVC, Color-Coded by System: **20 mils** (0.5 mm) **30 mils** (0.8 mm) thick.
 3. Aluminum, Smooth Corrugated Stucco Embossed: **0.016 inch** (0.41 mm) **0.020 inch** (0.51 mm) **0.024 inch** (0.61 mm) **0.032 inch** (0.81 mm) **0.040 inch** (1.0 mm) thick.
 4. Painted Aluminum, Smooth Corrugated Stucco Embossed: **0.016 inch** (0.41 mm) **0.020 inch** (0.51 mm) **0.024 inch** (0.61 mm) **0.032 inch** (0.81 mm) thick.
 5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish Corrugated Stucco Embossed: **0.010 inch** (0.25 mm) **0.016 inch** (0.41 mm) **0.020 inch** (0.51 mm) **0.024 inch** (0.61 mm) thick.
- D. Equipment, Exposed, up to **48 Inches** (1200 mm) in Diameter or with Flat Surfaces up to **72 Inches** (1800 mm):
1. Painted Aluminum, Smooth Corrugated Stucco Embossed with Z-Shaped Locking Seam: **0.016 inch** (0.41 mm) **0.020 inch** (0.51 mm) **0.024 inch** (0.61 mm) **0.032 inch** (0.81 mm) **0.040 inch** (1.0 mm) thick.

2. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish Corrugated Stucco Embossed with Z-Shaped Locking Seam: 0.010 inch (0.25 mm) 0.016 inch (0.41 mm) 0.020 inch (0.51 mm) 0.024 inch (0.61 mm) thick.
- E. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
1. Painted Aluminum, Smooth Stucco Embossed with 1-1/4-Inch- (32-mm-) Deep Corrugations 2-1/2-Inch- (65-mm-) Deep Corrugations 4-by-1-Inch (100-by-25-mm) Box Ribs: 0.032 inch (0.81 mm) 0.040 inch (1.0 mm) thick.
 2. Stainless Steel, Type 304 or Type 316, Smooth Stucco Embossed, with [1-1/4-Inch- (32-mm-) Deep Corrugations 2-1/2-Inch- (65-mm-) Deep Corrugations 4-by-1-Inch (100-by-25-mm) Box Ribs: 0.020 inch (0.51 mm) 0.024 inch (0.61 mm)] thick.

END OF SECTION 220716

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 220719 – PLUMBING
PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Sanitary waste piping exposed to freezing conditions.
3. Storm-water piping exposed to freezing conditions.
4. Roof drains and rainwater leaders.

- B. Related Sections:

1. Section 15084 "Plumbing Equipment Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

- B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies 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: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
- D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
 2. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
 3. Sheet Jacket Materials: 12 inches (300 mm) square.
 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

- a. One 10-foot (3-m) section of NPS 2 (DN 50) straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 (DN 50) or smaller valve, and one NPS 2-1/2 (DN 65) or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 4. Obtain Architect's approval of mockups before starting insulation application.
 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15061 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 5. Preformed Pipe Insulation with Factory-Applied [ASJ] [ASJ-SSL]: Comply with ASTM C 552, Type II, Class 2.
 - 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.

- I. Mineral-Fiber, Preformed Pipe Insulation:
 1. **Products:** Subject to compliance with requirements, **provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:**
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, **850 Deg F (454 Deg C)** Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket, with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- J. Phenolic:
 1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Kingspan Tarec Industrial Insulation NV; Koolphen K.
 - b. Resolco International BV; Insul-phen.
 2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.

3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
 4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 5. Factory-Applied Jacket: ASJ. Requirements are specified in "Factory-Applied Jackets" Article.
- K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Insulation; IMCOLOCK and NOMALOCK.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Thermokote V.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of **minus 100 to plus 200 deg F (minus 73 to plus 93 deg C)**.
1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive 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."
- E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of **minus 75 to plus 300 deg F (minus 59 to plus 149 deg C)**.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

- c. [P.I.C. Plastics, Inc.; Welding Adhesive.](#)
 - d. [Speedline Corporation; Polyco VP Adhesive.](#)
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."

2.4 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 available products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.](#)
 - b. [Vimasco Corporation; 749.](#)
 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 available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.](#)
 - b. [Eagle Bridges - Marathon Industries; 501.](#)
 - c. [Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.](#)
 - d. [Mon-Eco Industries, Inc.; 55-10.](#)
 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 available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
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 available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
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.

2.5 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 available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - d.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: **0 to plus 180 deg F (Minus 18 to plus 82 deg C).**
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. **Joint Sealants for Cellular-Glass and Phenolic Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).**
5. Color: White or gray.
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. FSK and Metal Jacket Flashing Sealants:

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
- 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."
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
- 1. Products: Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - 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."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
- 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately **2 oz./sq. yd. (68 g/sq. m)** with a thread count of **10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm)** for covering pipe and pipe fittings.
 - 1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.
- B. Woven Polyester Fabric: Approximately **1 oz./sq. yd. (34 g/sq. m)** with a thread count of **10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm)**, in a Leno weave, for pipe.
 - 1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of **8 oz./sq. yd. (271 g/sq. m)**.
 - 1. **Products:** Subject to compliance with requirements, provide the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.

- c. [Proto Corporation; LoSmoke.](#)
 - d. [Speedline Corporation; SmokeSafe.](#)
2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: Color as selected by Architect.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

1. [Products:](#) Subject to compliance with requirements, provide one of the following available products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.](#)
 - b. [ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.](#)
 - c. [RPR Products, Inc.; Insul-Mate.](#)
2. Aluminum Jacket: Comply with **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: [**1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper**] [**3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper**] [**2.5-mil- (0.063-mm-) thick polysurlyn**].
 - d. Moisture Barrier for Outdoor Applications: [**3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper**] [**2.5-mil- (0.063-mm-) thick polysurlyn**].
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. [**Sheet and roll stock ready for shop or field sizing**] [**Factory cut and rolled to size**].
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.

- c. Moisture Barrier for Indoor Applications: **[1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper]** **[3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper]** **[2.5-mil- (0.063-mm-) thick polysurlyn]**.
- d. Moisture Barrier for Outdoor Applications: **[3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper]** **[2.5-mil- (0.063-mm-) thick polysurlyn]**.
- e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: **125-mil- (3.2-mm-) thick** vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

- 1. **Products:** Subject to compliance with requirements, **[provide the following]** **[provide one of the following]** **[available products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard Products, Inc.; Insulrap No Torch 125.
 - c. **<Insert manufacturer's name; product name or designation>.**

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

- 1. **Products:** Subject to compliance with requirements, **[provide the following]** **[provide one of the following]** **[available products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - e. **<Insert manufacturer's name; product name or designation>.**
- 2. Width: **3 inches (75 mm).**
- 3. Thickness: **11.5 mils (0.29 mm).**
- 4. Adhesion: **90 ounces force/inch (1.0 N/mm)** in width.
- 5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. **Products:** Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - e. **<Insert manufacturer's name; product name or designation>.**
 2. Width: 3 inches (75 mm).
 3. Thickness: 6.5 mils (0.16 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. **Products:** Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - d. **<Insert manufacturer's name; product name or designation>.**
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. **Products:** Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.

- d. Venture Tape; 3520 CW.
- e. <Insert manufacturer's name; product name or designation>.

- 2. Width: **2 inches (50 mm).**
- 3. Thickness: **3.7 mils (0.093 mm).**
- 4. Adhesion: **100 ounces force/inch (1.1 N/mm)** in width.
- 5. Elongation: 5 percent.
- 6. Tensile Strength: **34 lbf/inch (6.2 N/mm)** in width.

2.12 SECUREMENTS

A. Bands:

- 1. Products: Subject to compliance with requirements, **[provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]**:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
 - c. <Insert manufacturer's name; product name or designation>.
- 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, **[Type 304] [or] [Type 316]; 0.015 inch (0.38 mm)** thick, **[1/2 inch (13 mm)] [3/4 inch (19 mm)]** wide with **[wing seal] [or] [closed seal]**.
- 3. Aluminum: **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch (0.51 mm)** thick, **[1/2 inch (13 mm)] [3/4 inch (19 mm)]** wide with **[wing seal] [or] [closed seal]**.

B. Staples: Outward-clinching insulation staples, nominal **3/4-inch- (19-mm-)** wide, stainless steel or Monel.

C. Wire: **[0.080-inch (2.0-mm) nickel-copper alloy] [0.062-inch (1.6-mm) soft-annealed, stainless steel] [0.062-inch (1.6-mm) soft-annealed, galvanized steel]**.

- 1. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]**:
 - a. C & F Wire.
 - b. <Insert manufacturer's name>.

2.13 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers, <Insert drawing designation>:

- 1. Manufacturers: Subject to compliance with requirements, **[provide products by the following] [provide products by one of the following] [available manufacturers**

offering products that may be incorporated into the Work include, but are not limited to, the following]:

- a. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro; a brand of IPS Corporation.
 - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - g. **<Insert manufacturer's name>.**
2. Description: Manufactured plastic wraps for covering plumbing fixture **[hot-water supply] [hot- and cold-water supplies]** and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures, **<Insert drawing designation>**:

1. **Manufacturers:** Subject to compliance with requirements, **[provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - a. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - c. **<Insert manufacturer's name>.**
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer **5 mils (0.127 mm)** thick and an epoxy finish **5 mils (0.127 mm)** thick if operating in a temperature range between **140 and 300 deg F (60 and 149 deg C)**. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between **32 and 300 deg F (0 and 149 deg C)** with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with **3-inch- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
 3. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [**2 inches (50 mm)**] [**4 inches (100 mm)**] o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches (100 mm)** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches (50 mm)**.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."
- 3.5 GENERAL PIPE INSULATION INSTALLATION
- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe

- insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches (50 mm)** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at **12-inch (300-mm)** intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least **3 inches (75 mm)**. Secure inner layer with **0.062-inch (1.6-mm)** wire spaced at **12-inch (300-mm)** intervals. Secure outer layer with stainless-steel bands at **12-inch (300-mm)** intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at **6 inches (150 mm)** o.c.
4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with **2-inch (50-mm)** overlap at seams and joints.
2. Embed glass cloth between two **0.062-inch- (1.6-mm-)** thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with **1-1/2-inch (38-mm)** laps at longitudinal seams and **3-inch- (75-mm-)** wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with **1-inch (25-mm)** overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with **2-inch (50-mm)** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches (300 mm)** o.c. and at end joints.

3.12 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09911 "Exterior Painting" and Section 09912 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.

3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. **NPS 1 (DN 25)** and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Flexible Elastomeric: **1/2 inch (13 mm) 3/4 inch (19 mm) 1 inch (25 mm)** thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm), 1 inch (25 mm)** thick.
 - d. Phenolic: **1 inch (25 mm)** thick.
 - e. Polyolefin: **1/2 inch (13 mm), 3/4 inch (19 mm), 1 inch (25 mm)** thick.
2. **NPS 1-1/4 (DN 32)** and Larger: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Flexible Elastomeric: **1 inch (25 mm)** thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.
 - d. Phenolic: **1 inch (25 mm)** thick.
 - e. Polyolefin: **1 inch (25 mm)** thick.

B. Domestic Hot and Recirculated Hot Water:

1. **NPS 1-1/4 (DN 32)** and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Flexible Elastomeric: **3/4 inch (19 mm) 1 inch (25 mm)** thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm), 1 inch (25 mm)** thick.
 - d. Phenolic: **1 inch (25 mm)** thick.
 - e. Polyolefin: **3/4 inch (19 mm), 1 inch (25 mm)** thick.
2. **NPS 1-1/2 (DN 40)** and Larger: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Flexible Elastomeric: **1 inch (25 mm)** thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.
 - d. Phenolic: **1 inch (25 mm)** thick.
 - e. Polyolefin: **1 inch (25 mm)** thick.

C. Domestic Chilled Water (Potable):

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Flexible Elastomeric: **1 inch (25 mm)** thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.

- d. Phenolic: **1 inch (25 mm)** thick.
- e. Polyolefin: **1 inch (25 mm)** thick.

D. Stormwater and Overflow:

- 1. All Pipe Sizes: Insulation shall be[**one of**] the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Flexible Elastomeric: **1 inch (25 mm)** thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.
 - d. Phenolic: **1 inch (25 mm)** thick.
 - e. Polyolefin: **1 inch (25 mm)** thick.

E. Roof Drain and Overflow Drain Bodies:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Flexible Elastomeric: **1 inch (25 mm)** thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.
 - d. Phenolic: **1 inch (25 mm)** thick.
 - e. Polyolefin: **1 inch (25 mm)** thick.

F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: **1/2 inch (13 mm), 3/4 inch (19 mm), 1 inch (25 mm)** thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm), 1 inch (25 mm)** thick.
 - c. Polyolefin: **1/2 inch (13 mm), 3/4 inch (19 mm), 1 inch (25 mm)** thick.

G. Sanitary Waste Piping Where Heat Tracing Is Installed:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **2 inches (50 mm)** thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1-1/2 inches (38 mm)** thick.
 - c. Phenolic: **1-1/2 inches (38 mm)** thick.

H. Floor Drains, Traps, and Sanitary Drain Piping within **10 Feet (3 m)** of Drain Receiving Condensate and Equipment Drain Water below **60 Deg F (16 Deg C)**:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Flexible Elastomeric: **3/4 inch (19 mm), 1 inch (25 mm)** thick.

- c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1/2 inch (13 mm), 1 inch (25 mm)** thick.
- d. Phenolic: **1 inch (25 mm)** thick.
- e. Polyolefin: **3/4 inch (19 mm), 1 inch (25 mm)** thick.

I. Hot Service Drains:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: **1 inch (25 mm)** thick.

J. Hot Service Vents:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: **1 inch (25 mm)** thick.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **2 inches (50 mm)** thick.
 - b. Flexible Elastomeric: **2 inches (50 mm)** thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **2 inches (50 mm)** thick.
 - d. Phenolic: **2 inches (50 mm)** thick.
 - e. Polyolefin: **2 inches (50 mm)** thick.

B. Domestic Hot and Recirculated Hot Water:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **2 inches (50 mm)** thick.
 - b. Flexible Elastomeric: **2 inches (50 mm)** thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: **2 inches (50 mm)** thick.
 - d. Phenolic: **2 inches (50 mm)** thick.
 - e. Polyolefin: **2 inches (50 mm)** thick.

C. Sanitary Waste Piping Where Heat Tracing Is Installed:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **2 inches (50 mm)** thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **2 inches (50 mm)** thick.
 - c. Phenolic: **2 inches (50 mm)** thick.

D. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch (25 mm)** thick.

E. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: **1-1/2 inches (38 mm)** thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type II: **1 inch (25 mm)** thick.

3.17 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, **2 inches (50 mm)** thick.
- B. Chilled Water, All Sizes: Cellular glass, **2 inches (50 mm)** thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
 2. PVC, Color-Coded by System: **20 mils (0.5 mm), 30 mils (0.8 mm)** thick.
 3. Aluminum, Smooth, Corrugated, Stucco Embossed: **0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm), 0.032 inch (0.81 mm), 0.040 inch (1.0 mm)** thick.
 4. Painted Aluminum, Smooth, Corrugated, Stucco Embossed: **0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm), 0.032 inch (0.81 mm)** thick.
 5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish, Corrugated, Stucco Embossed: **0.010 inch (0.25 mm), 0.016 inch (0.41 mm), 0.020 inch (0.51 mm)**.
 6. .
- D. Piping, Exposed:
 1. None.
 2. PVC, Color-Coded by System: **20 mils (0.5 mm), 30 mils (0.8 mm)** thick.
 3. Aluminum, Smooth, Corrugated, Stucco Embossed: **0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm), 0.032 inch (0.81 mm), 0.040 inch (1.0 mm)** thick.
 4. Painted Aluminum, Smooth, Corrugated, Stucco Embossed: **0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm), 0.032 inch (0.81 mm)** thick.

5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish, Corrugated, Stucco Embossed: **0.010 inch (0.25 mm), 0.016 inch (0.41 mm), 0.020 inch (0.51 mm)] 0.024 inch (0.61 mm)** thick.

3.19 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
 2. PVC, Color-Coded by System: **20 mils (0.5 mm), 30 mils (0.8 mm)]** thick.
 3. Aluminum, Smooth, Corrugated, Stucco Embossed: **0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm), 0.032 inch (0.81 mm), 0.040 inch (1.0 mm)** thick.
 4. Painted Aluminum, Smooth, Corrugated, Stucco Embossed: **0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm), 0.032 inch (0.81 mm)]** thick.
 5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish, Corrugated, Stucco Embossed: **0.010 inch (0.25 mm), 0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm)]** thick.
- D. Piping, Exposed:
 1. PVC: **20 mils (0.5 mm), 30 mils (0.8 mm), 40 mils (1.0 mm)** thick.
 2. Painted Aluminum, Smooth, Corrugated, Stucco Embossed with Z-Shaped Locking Seam: **0.016 inch (0.41 mm), 0.020 inch (0.51 mm), 0.024 inch (0.61 mm), 0.032 inch (0.81 mm), 0.040 inch (1.0 mm)** thick.
 3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish, Corrugated, Stucco Embossed with Z-Shaped Locking Seam: **0.010 inch (0.25 mm), 0.016 inch (0.41 mm), 0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)]** thick.

3.20 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH AIRPORT AUTHORITY PARKING GARAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 221110

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. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters.
7. Concrete bases.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: **100 psig (690 kPa)** minimum unless otherwise indicated.
2. Service Regulators: **65 psig (450 kPa), 100 psig (690 kPa)** minimum unless otherwise indicated.

3. Minimum Operating Pressure of Service Meter: **5 psig (34.5 kPa), 10 psig (69 kPa), 20 psig (138 kPa), 65 psig (450 kPa).**
- B. Natural-Gas System Pressure within Buildings: **0.5 psig (3.45 kPa)** or less, More than **0.5 psig (3.45 kPa)** but not more than **2 psig (13.8 kPa)**, More than **2 psig (13.8 kPa)** but not more than **5 psig (34.5 kPa).**
- C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than **0.5 psig (3.45 kPa)** but not more than **2 psig (13.8 kPa)**, and is reduced to secondary pressure of **0.5 psig (3.45 kPa)** or less.
- D. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than **2 psig (13.8 kPa)** but not more than **5 psig (34.5 kPa)**, and is reduced to secondary pressure of more than **0.5 psig (3.45 kPa)** but not more than **2 psig (13.8 kPa).**
- E. Natural-Gas System Pressures within Buildings: Three pressure ranges. Primary pressure is more than **2 psig (13.8 kPa)** but not more than **5 psig (34.5 kPa)**, and is reduced to secondary pressures of more than **0.5 psig (3.45 kPa)** but not more than **2 psig (13.8 kPa)**, and is reduced again to pressures of **0.5 psig (3.45 kPa)** or less.
- F. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 1. Piping specialties.
 2. Corrugated, stainless-steel tubing with associated components.
 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 4. Pressure regulators. Indicate pressure ratings and capacities.
 5. Service meters. Indicate pressure ratings and capacities. Include bypass fittings and meter bars, supports.
 6. Dielectric fittings.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
 1. Shop Drawing Scale: **1/4 inch per foot (1:50).**
 2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.
- C. Delegated-Design Submittal: For natural-gas piping and equipment 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. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- C. Qualification Data: For qualified professional engineer.
- D. Welding certificates.
- E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For motorized gas valves, pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- 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.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.10 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
 - 1. Notify Architect, Construction Manager or Owner no fewer than two days in advance of proposed interruption of natural-gas service.
 - 2. Do not proceed with interruption of natural-gas service without Architect's, Construction Manager's or Owner's written permission.

1.11 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 08311 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 - 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

- a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- 6. Mechanical Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Dresser Piping Specialties; Division of Dresser, Inc.
 - 2) Smith-Blair, Inc.
 - b. Stainless-steel flanges and tube with epoxy finish.
 - c. Buna-nitrile seals.
 - d. Stainless-steel bolts, washers, and nuts.
 - e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
 - 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 - 3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
 - 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 - 5. Striker Plates: Steel, designed to protect tubing from penetrations.
 - 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 - 7. Operating-Pressure Rating: 5 psig (34.5 kPa).
- C. Aluminum Tubing: Comply with ASTM B 210 and ASTM B 241/B 241M.

1. Aluminum Alloy: Alloy 5456 is prohibited.
 2. Protective Coating: Factory-applied coating capable of resisting corrosion on tubing in contact with masonry, plaster, insulation, water, detergents, and sewerage.
 3. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper-alloy fittings.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads shall comply with ASME B1.20.3.
- D. Drawn-Temper Copper Tube: Comply with **ASTM B 88, Type K** (**ASTM B 88M, Type A**), **ASTM B 88, Type L** (**ASTM B 88M, Type B**), ASTM B 837, Type G.
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
 2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.
 - a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.
 3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of **0.022 inch** (**0.56 mm**) thick.
- E. Annealed-Temper Copper Tube: Comply with **ASTM B 88, Type K** (**ASTM B 88M, Type A**), **ASTM B 88, Type L** (**ASTM B 88M, Type B**), ASTM B 837, Type G.
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
 2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.
 3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of **0.022 inch** (**0.56 mm**) thick.
- F. Tin-Lined Copper Tube: ASTM B 280, seamless, annealed, with interior tin-plated lining.
1. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.
- G. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or flanged or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
4. Transition Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
 - b. Outlet shall be threaded or flanged or suitable for welded connection.
 - c. Bridging sleeve over mechanical coupling.
 - d. Factory-connected anode.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
5. Plastic Mechanical Couplings, **NPS 1-1/2 (DN 40)** and Smaller: Capable of joining PE pipe to PE pipe.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Lyall, R. W. & Company, Inc.
 - 2) Mueller Co.; Gas Products Div.
 - 3) Perfection Corporation; a subsidiary of American Meter Company.
 - b. PE body with molded-in, stainless-steel support ring.
 - c. Buna-nitrile seals.
 - d. Acetal collets.
 - e. Electro-zinc-plated steel stiffener.
6. Plastic Mechanical Couplings, **NPS 2 (DN 50)** and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Lyall, R. W. & Company, Inc.
 - 2) Mueller Co.; Gas Products Div.
 - 3) Perfection Corporation; a subsidiary of American Meter Company.

- b. Fiber-reinforced plastic body.
 - c. PE body tube.
 - d. Buna-nitrile seals.
 - e. Acetal collets.
 - f. Stainless-steel bolts, nuts, and washers.
7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Dresser Piping Specialties; Division of Dresser, Inc.
 - 2) Smith-Blair, Inc.
 - b. Stainless-steel flanges and tube with epoxy finish.
 - c. Buna-nitrile seals.
 - d. Stainless-steel bolts, washers, and nuts.
 - e. Factory-installed anode for steel-body couplings installed underground.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

- 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
- 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
- 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
- 4. Corrugated stainless-steel tubing with polymer coating.
- 5. Operating-Pressure Rating: **0.5 psig (3.45 kPa)**.
- 6. End Fittings: Zinc-coated steel.
- 7. Threaded Ends: Comply with ASME B1.20.1.
- 8. Maximum Length: **72 inches (1830 mm.)**

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

- 1. Copper-alloy convenience outlet and matching plug connector.
- 2. Nitrile seals.
- 3. Hand operated with automatic shutoff when disconnected.
- 4. For indoor or outdoor applications.
- 5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

- 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
- 2. End Connections: Threaded ends for **NPS 2 (DN 50)** and smaller; flanged ends for **NPS 2-1/2 (DN 65)** and larger.
- 3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 125 psig (862 kPa).

D. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

E. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40 or 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig (5170 kPa).

- F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 1. CWP Rating: 125 psig (862 kPa).
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.

4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves **1 inch (25 mm)** and smaller.
 6. Service Mark: Valves **1-1/4 inches (32 mm)** to **NPS 2 (DN 50)** shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, **NPS 2-1/2 (DN 65)** and Larger: Comply with ASME B16.38.
1. CWP Rating: **125 psig (862 kPa)**.
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated brass.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Separate packnut with adjustable-stem packing threaded ends.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: **600 psig (4140 kPa)**.
 9. Listing: Valves **NPS 1 (DN 25)** and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.

- c. [Lyall, R. W. & Company, Inc.](#)
 - d. [McDonald, A. Y. Mfg. Co.](#)
 - e. [Perfection Corporation; a subsidiary of American Meter Company.](#)
2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig (4140 kPa).
 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. [BrassCraft Manufacturing Company; a Masco company.](#)
 - b. [Conbraco Industries, Inc.; Apollo Div.](#)
 - c. [Lyall, R. W. & Company, Inc.](#)
 - d. [McDonald, A. Y. Mfg. Co.](#)
 - e. [Perfection Corporation; a subsidiary of American Meter Company.](#)
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig (4140 kPa).
 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. Bronze Plug Valves: MSS SP-78.
1. [Manufacturers](#): Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. [Lee Brass Company.](#)
 - b. [McDonald, A. Y. Mfg. Co.](#)
 2. Body: Bronze, complying with ASTM B 584.

3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig (862 kPa).
7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. McDonald, A. Y. Mfg. Co.
 - b. Mueller Co.; Gas Products Div.
 - c. Xomox Corporation; a Crane company.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

I. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Flowserve.
 - b. Homestead Valve; a division of Olson Technologies, Inc.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Milliken Valve Company.
 - e. Mueller Co.; Gas Products Div.
 - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: **125 psig (862 kPa)**.
9. Listing: Valves **NPS 1 (DN 25)** and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

J. PE Ball Valves: Comply with ASME B16.40.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Kerotest Manufacturing Corp.
 - b. Lyall, R. W. & Company, Inc.
 - c. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: PE.
3. Ball: PE.
4. Stem: Acetal.
5. Seats and Seals: Nitrile.
6. Ends: Plain or fusible to match piping.
7. CWP Rating: **80 psig (552 kPa)**.
8. Operating Temperature: **Minus 20 to plus 140 deg F (Minus 29 to plus 60 deg C)**.
9. Operator: Nut or flat head for key operation.
10. Include plastic valve extension.
11. Include tamperproof locking feature for valves where indicated on Drawings.

K. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of **5 inches (125 mm)** in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. ASCO Power Technologies, LP; Division of Emerson.
 - b. Dungs, Karl, Inc.

- c. [Eaton Corporation; Controls Div.](#)
 - d. [Eclipse Combustion, Inc.](#)
 - e. [Honeywell International Inc.](#)
 - f. [Johnson Controls.](#)
- 3. Body: Brass or aluminum.
 - 4. Seats and Disc: Nitrile rubber.
 - 5. Springs and Valve Trim: Stainless steel.
 - 6. Normally closed.
 - 7. Visual position indicator.
 - 8. **Electrical** or **Mechanical** operator for actuation by appliance automatic shutoff device.
- B. Electrically Operated Valves: Comply with UL 429.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 2. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [ASCO Power Technologies, LP; Division of Emerson.](#)
 - b. [Dungs, Karl, Inc.](#)
 - c. [Eclipse Combustion, Inc.](#)
 - d. [Goyen Valve Corp.; Tyco Environmental Systems.](#)
 - e. [Magnetrol Valve Corporation.](#)
 - f. [Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.](#)
 - g. [Watts Regulator Co.; Division of Watts Water Technologies, Inc.](#)
 - 3. Pilot operated.
 - 4. Body: Brass or aluminum.
 - 5. Seats and Disc: Nitrile rubber.
 - 6. Springs and Valve Trim: Stainless steel.
 - 7. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
 - 8. NEMA ICS 6, Type 4, coil enclosure.
 - 9. Normally closed.
 - 10. Visual position indicator.

2.6 EARTHQUAKE VALVES

- A. Earthquake Valves: Comply with ASCE 25.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 2. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Vanguard Valves, Inc.](#)

3. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
4. Maximum Operating Pressure: **5 psig (34.5 kPa)**.
5. Cast-aluminum body with nickel-plated chrome steel internal parts.
6. Nitrile-rubber valve washer.
7. Sight windows for visual indication of valve position.
8. Threaded end connections complying with ASME B1.20.1.
9. Wall mounting bracket with bubble level indicator.

B. Earthquake Valves: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Pacific Seismic Products, Inc.
3. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
4. Maximum Operating Pressure: **0.5 psig (3.45 kPa), 7 psig (48 kPa), 60 psig (414 kPa)**.
5. Cast-aluminum body with stainless-steel internal parts.
6. Nitrile-rubber, reset-stem o-ring seal.
7. Valve position, open or closed, indicator.
8. Composition valve seat with clapper held by spring or magnet locking mechanism.
9. Level indicator.
10. End Connections: Threaded for valves **NPS 2 (DN 50)** and smaller; flanged for valves **NPS 2-1/2 (DN 65)** and larger.

2.7 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators **NPS 2 (DN 50)** and smaller; flanged for regulators **NPS 2-1/2 (DN 65)** and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.

- d. [Invensys](#).
 - e. [Richards Industries; Jordan Valve Div.](#)
3. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 4. Springs: Zinc-plated steel; interchangeable.
 5. Diaphragm Plate: Zinc-plated steel.
 6. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 7. Orifice: Aluminum; interchangeable.
 8. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 9. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 10. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 11. Overpressure Protection Device: Factory mounted on pressure regulator.
 12. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
 13. Maximum Inlet Pressure: **100 psig (690 kPa)**.

C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 2. [Basis-of-Design Product](#): Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Actaris](#).
 - b. [American Meter Company](#).
 - c. [Eclipse Combustion, Inc.](#)
 - d. [Fisher Control Valves and Regulators; Division of Emerson Process Management](#).
 - e. [Invensys](#).
 - f. [Maxitrol Company](#).
 - g. [Richards Industries; Jordan Valve Div.](#)
3. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 4. Springs: Zinc-plated steel; interchangeable.
 5. Diaphragm Plate: Zinc-plated steel.
 6. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 7. Orifice: Aluminum; interchangeable.
 8. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 9. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 10. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 11. Overpressure Protection Device: Factory mounted on pressure regulator.
 12. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
 13. Maximum Inlet Pressure: **2 psig (13.8 kPa), 5 psig (34.5 kPa) or 10 psig (69 kPa)**.

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
3. Body and Diaphragm Case: Die-cast aluminum.
4. Springs: Zinc-plated steel; interchangeable.
5. Diaphragm Plate: Zinc-plated steel.
6. Seat Disc: Nitrile rubber.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
9. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
10. Maximum Inlet Pressure: **1 psig** (6.9 kPa), **2 psig** (13.8 kPa) or **5 psig** (34.5 kPa).

2.8 SERVICE METERS

A. Diaphragm-Type Service Meters: Comply with ANSI B109.1 or ANSI B109.2.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Invensys.
3. Case: Die-cast aluminum.
4. Connections: Steel threads.
5. Diaphragm: Synthetic fabric.
6. Diaphragm Support Bearings: Self-lubricating.
7. Compensation: Continuous temperature and pressure.
8. Meter Index: Cubic feet and liters.
9. Meter Case and Index: Tamper resistant.
10. Remote meter reader compatible.
11. Maximum Inlet Pressure: **100 psig** (690 kPa).
12. Pressure Loss: Maximum **0.5-inch wg** (124 Pa), **2.0-inch wg** (498 Pa).
13. Accuracy: Maximum plus or minus 1.0 percent.

B. Rotary-Type Service Meters: Comply with ANSI B109.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Meter Company.
 - b. Invensys.
3. Case: Extruded aluminum.
4. Connection: Flange.
5. Impellers: Polished aluminum.
6. Rotor Bearings: Self-lubricating.
7. Compensation: Continuous temperature and pressure.
8. Meter Index: Cubic feet and liters.
9. Tamper resistant.
10. Remote meter reader compatible.
11. Maximum Inlet Pressure: 100 psig (690 kPa).
12. Accuracy: Maximum plus or minus 2.0 percent.

C. Turbine Meters: Comply with ASME MFC-4M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. American Meter Company.
 - b. Invensys.
3. Housing: Cast iron or welded steel.
4. Connection Threads or Flanges: Steel.
5. Turbine: Aluminum or plastic.
6. Turbine Bearings: Self-lubricating.
7. Compensation: Continuous temperature and pressure.
8. Meter Index: Cubic feet and liters.
9. Tamper resistant.
10. Remote meter reader compatible.
11. Maximum Inlet Pressure: 100 psig (690 kPa).
12. Accuracy: Maximum plus or minus 2.0 percent.

D. Service-Meter Bars:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Mueller Co.; Gas Products Div.
 - f. Perfection Corporation; a subsidiary of American Meter Company.
3. Malleable- or cast-iron frame for supporting service meter.
4. Include offset swivel pipes, meter nuts with o-ring seal, and factory- or field-installed dielectric unions.
5. Omit meter offset swivel pipes if service-meter bar dimensions match service-meter connections.

E. Service-Meter Bypass Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Lyall, R. W. & Company, Inc.
 - b. Williamson, T. D., Inc.
3. Ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply.
4. Integral ball-check bypass valve.

2.9 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.

2. Description:

- a. Standard: ASSE 1079.
- b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C), 150 psig (1035 kPa), 250 psig (1725 kPa).
- c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Capitol Manufacturing Company.
- b. Central Plastics Company.
- c. Matco-Norca, Inc.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- e. Wilkins; a Zurn company.

2. Description:

- a. Standard: ASSE 1079.
- b. Factory-fabricated, bolted, companion-flange assembly.
- c. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C), 150 psig (1035 kPa), 175 psig (1200 kPa), 300 psig (2070 kPa).
- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Central Plastics Company.
- d. Pipeline Seal and Insulator, Inc.

2. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig (1035 kPa).
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

2.10 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of **6 inches (150 mm)** wide and **4 mils (0.1 mm)** thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to **30 inches (750 mm)** deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least **36 inches (900 mm)** below finished grade. Comply with requirements in Section 02300 "Earthwork" for excavating, trenching, and backfilling.
 - 1. If natural-gas piping is installed less than **36 inches (900 mm)** below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - 3. Replace pipe having damaged PE coating with new pipe.

- E. Copper Tubing with Protective Coating:
 - 1. Apply joint cover kits over tubing to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.
- G. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section 15127 "Meters and Gages for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 5. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

- V. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Section 15127 "Meters and Gages for HVAC Piping."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15093 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15093 "Sleeves and Sleeve Seals for HVAC Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15098 "Escutcheons for HVAC Piping."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

- A. Install service-meter assemblies aboveground, on concrete bases.
- B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator and meter set.
- D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.
- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- F. Install service meters downstream from pressure regulators.
- G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 05500 "Metal Fabrications" for pipe bollards.

3.6 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.7 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 15074 "Vibration and Seismic Controls for."
- B. Comply with requirements for pipe hangers and supports specified in Section 15062 "Hangers and Supports for HVAC Piping and Equipment."

- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. **NPS 1 (DN 25)** and Smaller: Maximum span, **96 inches (2438 mm)**; minimum rod size, **3/8 inch (10 mm)**.
 2. **NPS 1-1/4 (DN 32)**: Maximum span, **108 inches (2743 mm)**; minimum rod size, **3/8 inch (10 mm)**.
 3. **NPS 1-1/2 and NPS 2 (DN 40 and DN 50)**: Maximum span, **108 inches (2743 mm)**; minimum rod size, **3/8 inch (10 mm)**.
 4. **NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90)**: Maximum span, **10 feet (3 m)**; minimum rod size, **1/2 inch (13 mm)**.
 5. **NPS 4 (DN 100)** and Larger: Maximum span, **10 feet (3 m)**; minimum rod size, **5/8 inch (15.8 mm)**.
- D. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
1. **NPS 3/8 (DN 10)**: Maximum span, **48 inches (1220 mm)**; minimum rod size, **3/8 inch (10 mm)**.
 2. **NPS 1/2 and NPS 5/8 (DN 15 and DN 18)**: Maximum span, **72 inches (1830 mm)**; minimum rod size, **3/8 inch (10 mm)**.
 3. **NPS 3/4 and NPS 7/8 (DN 20 and DN 22)**: Maximum span, **84 inches (2134 mm)**; minimum rod size, **3/8 inch (10 mm)**.
 4. **NPS 1 (DN 25)**: Maximum span, **96 inches (2440 mm)**; minimum rod size, **3/8 inch (10 mm)**.
- E. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
1. **NPS 3/8 (DN 10)**: Maximum span, **48 inches (1220 mm)**; minimum rod size, **3/8 inch (10 mm)**.
 2. **NPS 1/2 (DN 15)**: Maximum span, **72 inches (1830 mm)**; minimum rod size, **3/8 inch (10 mm)**.
 3. **NPS 3/4 (DN 20)** and Larger: Maximum span, **96 inches (2440 mm)**; minimum rod size, **3/8 inch (10 mm)**.

3.9 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within **72 inches (1800 mm)** of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 15077 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.11 PAINTING

- A. Comply with requirements in Section 09911 "Exterior Painting" and Section 09912 "Interior Painting" for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (flat), (semigloss) or (gloss).
 - d. Color: Gray.
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive or Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (flat), (low sheen), (eggshell), (satin), (semigloss) or (gloss).
 - d. Color: Gray.
 - 2. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Alkyd anticorrosive or Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (flat), (eggshell), (semigloss) or (gloss).
 - d. Color: Gray.
- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to local seismic codes.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Use 3000-psig (20.7-MPa), 28-day, compressive-strength concrete and reinforcement as specified in Section 03300 "Cast-in-Place Concrete.", Section 03301 "Miscellaneous Cast-in-Place Concrete."

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.14 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.15 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas pipings shall be one of the following:
 - 1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
 - 2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
 - 3. Annealed or Drawn-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.

- B. Aboveground natural-gas piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
 2. Steel pipe with wrought-steel fittings and welded joints.
 3. Annealed or Drawn-temper copper tube with wrought-copper fittings and brazed joints.
- C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed or flared joints. Install piping embedded in concrete with no joints in concrete.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN **0.5 PSIG (3.45 kPa)**

- A. Aboveground, branch piping **NPS 1 (DN 25)** and smaller shall be one of the following:
1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
 3. Annealed-temper, copper tube with wrought-copper fittings and brazed or flared joints.
 4. Aluminum tube with flared fittings and joints.
 5. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
 2. Steel pipe with wrought-steel fittings and welded joints.
 3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
- C. Underground, below building, piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
 2. Steel pipe with wrought-steel fittings and welded joints.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.17 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN **0.5 PSIG (3.45 kPa)** AND LESS THAN **5 PSIG (34.5 kPa)**

- A. Aboveground, branch piping **NPS 1 (DN 25)** and smaller shall be one of the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
 3. Annealed-temper, copper tube with wrought-copper fittings and brazed or flared joints.
 4. Aluminum tube with flared fittings and joints.
 5. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
 2. Steel pipe with steel welding fittings and welded joints.
 3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
- C. Underground, below building, piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
 2. Steel pipe with wrought-steel fittings and welded joints.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.
- 3.18 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 5 PSIG (34.5 kPa)
- A. Aboveground Piping: Maximum operating pressure more than 5 psig (34.5 kPa).
- B. Aboveground, Branch Piping: Steel pipe with steel welding fittings and welded joints.
- C. Aboveground, distribution piping shall be one of the following:
1. Steel pipe with steel welding fittings and welded joints.
 2. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
- D. Underground, below building, piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
 2. Steel pipe with wrought-steel fittings and welded joints.
- E. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- F. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.19 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground:
 - 1. PE valves.
 - 2. **NPS 2 (DN 50)** and Smaller: Bronze plug valves.
 - 3. **NPS 2-1/2 (DN 65)** and Larger: Cast-iron, lubricated plug valves.

3.20 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes **NPS 2 (DN 50)** and smaller at service meter shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, full or regular-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.
- B. Valves for pipe sizes **NPS 2-1/2 (DN 65)** and larger at service meter shall be one of the following:
 - 1. Two-piece, full or regular-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - 3. Cast-iron, nonlubricated plug valve.
- C. Distribution piping valves for pipe sizes **NPS 2 (DN 50)** and smaller shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, full or regular-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.
- D. Distribution piping valves for pipe sizes **NPS 2-1/2 (DN 65)** and larger shall be one of the following:
 - 1. Two-piece, full or regular-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - 3. Cast-iron, lubricated plug valve.
- E. Valves in branch piping for single appliance shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, full or regular-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.

END OF SECTION 221110

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 221116 – DOMESTIC
WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
- 2. Encasement for piping.

B. Related Requirements:

- 1. Section 02510 "Water Distribution" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

B. LEED Submittals:

- 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
- 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."

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Architect, Construction Manager or Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Architect's, Construction Manager's or Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: **ASTM B 88, Type L (ASTM B 88M, Type B)** and **ASTM B 88, Type M (ASTM B 88M, Type C)** water tube, drawn temper.
- B. Soft Copper Tube: **ASTM B 88, Type K (ASTM B 88M, Type A)** and **ASTM B 88, Type L (ASTM B 88M, Type B)** water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- G. Copper Pressure-Seal-Joint Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. [Elkhart Products Corporation.](#)
 - b. [NIBCO Inc.](#)
 - c. [Viega.](#)
 - 3. Fittings for **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
 - 4. Fittings for **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- H. Copper Push-on-Joint Fittings:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. [Basis-of-Design Product](#): Subject to compliance with requirements, provide product indicated on Drawings or comparable product by the following:
 - a. [Victaulic Company.](#)
 - 3. Description:
 - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
 - b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.
- I. Copper-Tube, Extruded-Tee Connections:
- 1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. [Basis-of-Design Product](#): Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [T-Drill Industries Inc.](#)
 - 3. Description: Tee formed in copper tube according to ASTM F 2014.
- J. Appurtenances for Grooved-End Copper Tubing:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. [Basis-of-Design Product](#): Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Anvil International.](#)
 - b. [Shurjoint Piping Products.](#)
 - c. [Victaulic Company.](#)

3. Bronze Fittings for Grooved-End, Copper Tubing: **ASTM B 75 (ASTM B 75M)** copper tube or ASTM B 584 bronze castings.
4. Mechanical Couplings for Grooved-End Copper Tubing:
 - a. Copper-tube dimensions and design similar to AWWA C606.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating: **300 psig (2070 kPa)**.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51.
2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

E. Standard-Pattern, Push-on-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Gaskets: AWWA C111/A21.11, rubber.

F. Compact-Pattern, Push-on-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Gaskets: AWWA C111/A21.11, rubber.

G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

H. Appurtenances for Grooved-End, Ductile-Iron Pipe:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Shurjoint Piping Products.
 - b. Star Pipe Products.
 - c. Victaulic Company.
3. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.
4. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
 - a. AWWA C606 for ductile-iron-pipe dimensions.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating:
 - 1) **NPS 14 to NPS 18 (DN 350 to DN 450): 250 psig (1725 kPa).**
 - 2) **NPS 20 to NPS 46 (DN 500 to DN 900): 150 psig (1035 kPa).**

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe:
 1. ASTM A 53/A 53M, Type E, Grade B, Standard Weight.
 2. Include ends matching joining method.
- B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
- C. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Malleable-Iron Unions:
 1. ASME B16.39, Class 150.
 2. Hexagonal-stock body.
 3. Ball-and-socket, metal-to-metal, bronze seating surface.
 4. Threaded ends.
- E. Flanges: ASME B16.1, Class 125, cast iron.
- F. Appurtenances for Grooved-End, Galvanized-Steel Pipe:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anvil International.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.
 - e.
3. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Fittings for Grooved-End, Galvanized-Steel Pipe:
 - a. AWWA C606 for steel-pipe dimensions.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating:
 - 1) **NPS 8 (DN 200) and Smaller: 600 psig (4137 kPa).**
 - 2) **NPS 10 and NPS 12 (DN 250 to DN 300): 400 psig (2758 kPa).**
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600): 250 psig (1725 kPa).**

2.5 STAINLESS-STEEL PIPING

- A. Potable-water piping and components shall comply with NSF 61.
- B. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 10 and Schedule 40.
- C. Stainless-Steel Pipe Fittings: ASTM A 815/A 815M.
- D. Appurtenances for Grooved-End, Stainless-Steel Pipe:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anvil International.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.
 3. Fittings for Grooved-End, Stainless-Steel Pipe: Stainless-steel casting with dimensions matching stainless-steel pipe.
 4. Mechanical Couplings for Grooved-End, Stainless-Steel Pipe:
 - a. AWWA C606 for stainless-steel-pipe dimensions.

- b. Stainless-steel housing sections.
- c. Stainless-steel bolts and nuts.
- d. EPDM-rubber gaskets suitable for hot and cold water.
- e. Minimum Pressure Rating:
 - 1) **NPS 8 (DN 200) and Smaller: 600 psig (4137 kPa).**
 - 2) **NPS 10 and NPS 12 (DN 250 to DN 300): 400 psig (2758 kPa).**
 - 3) **NPS 14 to NPS 24 (DN 350 to DN 600): 250 psig (1725 kPa).**

2.6 CPVC PIPING

- A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40 and Schedule 80.
 - 1. CPVC Socket Fittings: ASTM F 438 for Schedule 40 and ASTM F 439 for Schedule 80.
 - 2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
- B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
- C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.7 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
- B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

2.8 PEX-AL-PEX TUBE AND FITTINGS

- A. PEX-AL-PEX Distribution System: ASTM F 1281 tubing.
- B. Fittings for PEX-AL-PEX Tube: ASTM F 1281, metal-insert type with copper or stainless-steel crimp rings and matching PEX-AL-PEX tube dimensions.

2.9 PEX-AL-HDPE TUBE AND FITTINGS

- A. PEX-AL-HPDE Distribution System: ASTM F 1986 tubing.
- B. Fittings for PEX-AL-HDPE Tube: ASTM F 1986, metal-insert type with copper or stainless-steel crimp ring and matching PEX-AL-HDPE tube dimensions

2.10 PVC PIPE AND FITTINGS

- A. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.

- B. PVC Socket Fittings: ASTM D 2466 for Schedule 40 and ASTM D 2467 for Schedule 80.
- C. PVC Schedule 80 Threaded Fittings: ASTM D 2464.

2.11 PP PIPE AND FITTINGS

- A. PP Pipe: ASTM F 2389, SDR 7.4 and SDR 11.
- B. PVC Socket Fittings: ASTM F 2389.

2.12 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
 - 1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.13 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

2.14 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Piping Specialties Products.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.
- D. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.

3. Description:
 - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO Inc.
 - c. Spears Manufacturing Company.
3. Description:
 - a. CPVC or PVC four-part union.
 - b. Brass or stainless-steel threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.15 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International.
 - e. Matco-Norca.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
 3. Standard: ASSE 1079.

4. Pressure Rating: **125 psig (860 kPa)** minimum at **180 deg F (82 deg C)**, **150 psig (1035 kPa)** or **250 psig (1725 kPa)**.
5. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Watts; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
3. Standard: ASSE 1079.
4. Factory-fabricated, bolted, companion-flange assembly.
5. Pressure Rating: **125 psig (860 kPa)** minimum at **180 deg F (82 deg C)**, **150 psig (1035 kPa)**, **175 psig (1200 kPa)** or **300 psig (2070 kPa)**.
6. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
3. Nonconducting materials for field assembly of companion flanges.
4. Pressure Rating: **150 psig (1035 kPa)**.
5. Gasket: Neoprene or phenolic.
6. Bolt Sleeves: Phenolic or polyethylene.
7. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. [Elster Perfection Corporation.](#)
 - b. [Grinnell Mechanical Products; Tyco Fire Products LP.](#)
 - c. [Matco-Norca.](#)
 - d. [Precision Plumbing Products, Inc.](#)
 - e. [Victaulic Company.](#)
- 3. Standard: IAPMO PS 66.
 - 4. Electroplated steel nipple complying with ASTM F 1545.
 - 5. Pressure Rating and Temperature: **300 psig (2070 kPa) at 225 deg F (107 deg C).**
 - 6. End Connections: Male threaded or grooved.
 - 7. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 02300 "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 15126 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 15145 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 15145 "Domestic Water Piping Specialties."
- H. Install domestic water piping level with 0.25 percent slope downward toward drain without pitch and plumb.

- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 15073 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping to permit valve servicing.
- O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install PEX piping with loop at each change of direction of more than 90 degrees.
- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 15126 "Meters and Gages for Plumbing Piping."
- U. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 15441 "Domestic Water Pumps."
- V. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 15126 "Meters and Gages for Plumbing Piping."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15097 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Square cut Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

- M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Piping: Join according to ASTM D 2855.
- N. Joints for PEX Piping: Join according to ASTM F 1807.
- O. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for **NPS 1-1/2 (DN 40)** and Smaller: Fitting-type coupling.
 - 2. Fittings for **NPS 2 (DN 50)** and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping **NPS 2 (DN 50)** and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for **NPS 2 (DN 50)** and Smaller: Use dielectric couplings, nipples or unions.
- C. Dielectric Fittings for **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Use dielectric flanges, flange kits or nipples.
- D. Dielectric Fittings for **NPS 5 (DN 125)** and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 15073 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 15061 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. **100 Feet (30 m)** and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than **100 Feet (30 m)**: MSS Type 43, adjustable roller hangers.

- c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
- 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- F. Install supports for vertical copper tubing every 10 feet (3 m).
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - 8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical steel piping every 15 feet (4.5 m).
- I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - 8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

- J. Install supports for vertical stainless-steel piping every 15 feet (4.5 m).
- K. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 5. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 6. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- L. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
- M. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.
- N. Install hangers for vertical PEX piping every 48 inches (1200 mm).
- O. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 2. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 5. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- P. Install supports for vertical PVC piping every 48 inches (1200 mm).
- Q. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 5. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 6. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

- R. Install supports for vertical PP piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
- S. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 15076 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

- 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of **50 psig (345 kPa)** above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.

7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least **50 ppm (50 mg/L)** of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least **200 ppm (200 mg/L)** of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- #### A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, **NPS 3 (DN 80)** and smaller, shall be one of the following:
 - 1. Soft copper tube, **ASTM B 88, Type K (ASTM B 88M, Type A)** or **ASTM B 88, Type L (ASTM B 88M, Type B)**; wrought-copper, solder-joint fittings; and brazed copper pressure-seal fittings; and pressure-sealed joints.
 - 2. PVC, Schedule 40 or Schedule 80; socket fittings; and solvent-cemented joints.
 - 3. PP, SDR 7.4 or SDR 11 socket fittings; and fusion-welded joints.
- E. Under-building-slab, domestic water, building-service piping, **NPS 4 to NPS 8 (DN 100 to DN 200)** and larger, shall be one of the following:
 - 1. Soft copper tube, [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**]; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Mechanical-joint, ductile-iron pipe; standard or compact pattern, mechanical-joint fittings; and mechanical joints.
 - 3. Push-on-joint, ductile-iron pipe; standard or compact pattern, push-on-joint fittings; and gasketed joints.
 - 4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
 - 5. PVC, Schedule 40 or Schedule 80; socket fittings; and solvent-cemented joints.
 - 6. PP, SDR 7.4 or SDR 11 socket fittings; and fusion-welded joints.
- F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, **NPS 6 to NPS 12 (DN 150 to DN 300)**, shall be one of the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard or compact pattern, mechanical-joint fittings; and mechanical joints.
 - 2. Push-on-joint, ductile-iron pipe; standard or compact pattern, push-on-joint fittings; and gasketed joints.
 - 3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- G. Under-building-slab, domestic water piping, **NPS 2 (DN 50)** and smaller, shall be one of the following:
 - 1. Hard or soft copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)**; wrought-copper, solder-joint fittings; and brazed or copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 2. PVC, Schedule 40 or Schedule 80; socket fittings; and solvent-cemented joints.
 - 3. PP, SDR 7.4 or SDR 11 socket fittings; and fusion-welded joints.
- H. Aboveground domestic water piping, **NPS 2 (DN 50)** and smaller, shall be one of the following:

1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 2. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)** or **ASTM B 88, Type M (ASTM B 88M, Type C)**; cast or wrought copper, solder-joint fittings; and brazed or soldered joints.
 3. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)** or **ASTM B 88, Type M (ASTM B 88M, Type C)**; copper pressure-seal-joint fittings; and pressure-sealed joints.
 4. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)** or **ASTM B 88, Type M (ASTM B 88M, Type C)**; copper push-on-joint fittings; and push-on joints.
 5. CPVC, Schedule 40 or Schedule 80; socket fittings; and solvent-cemented joints.
 6. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 7. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints. **NPS 1-1/2 (DN 40)** and **NPS 2 (DN 50)** CPVC pipe with CPVC socket fittings may be used instead of tubing.
 8. PEX tube, **NPS 1 (DN 25)** and smaller; fittings for PEX tube; and crimped joints.
 9. PE-AL-PE tube, **NPS 1 (DN 25)** and smaller; fittings for PE-AL-PE tube; and crimped joints.
 10. PEX-AL-PEX tube, **NPS 1 (DN 25)** and smaller; fittings for PEX-AL-PEX tube; and crimped joints.
 11. PVC, Schedule 40 or Schedule 80; socket fittings; and solvent-cemented joints.
 12. PP, SDR 7.4 or SDR 11 socket fittings; and fusion-welded joints.
- I. Aboveground domestic water piping, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**, shall be one of the following:
1. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)** or **ASTM B 88, Type M (ASTM B 88M, Type C)**; cast or wrought copper, solder-joint fittings; and brazed or soldered joints.
 2. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)** or **ASTM B 88, Type M (ASTM B 88M, Type C)**; copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)** or **ASTM B 88, Type M (ASTM B 88M, Type C)**; grooved-joint, copper-tube appurtenances; and grooved joints.
 4. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 5. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 6. CPVC, Schedule 40 or Schedule 80; socket fittings; and solvent-cemented joints.
 7. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 8. PVC, Schedule 40 or Schedule 80; socket fittings; and solvent-cemented joints.
 9. PP, SDR 7.4 or SDR 11 socket fittings; and fusion-welded joints.
- J. Aboveground domestic water piping, **NPS 5 to NPS 8 (DN 125 to DN 200)**, shall be one of the following:
1. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)** or **ASTM B 88, Type M (ASTM B 88M, Type C)**; cast or wrought copper, solder-joint fittings; and brazed or soldered joints.

2. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)** or **ASTM B 88, Type M (ASTM B 88M, Type C)**]; grooved-joint, copper-tube appurtenances; and grooved joints.
 3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 4. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 5. Stainless-steel Schedule 10 or Schedule 40 pipe, grooved-joint fittings, and grooved joints.
 6. CPVC, Schedule 40 or Schedule 80; socket fittings; and solvent-cemented joints.
 7. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 8. PVC, Schedule 40 or Schedule 80; socket fittings; and solvent-cemented joints.
- K. Aboveground, combined domestic water-service and fire-service-main piping, **NPS 6 to NPS 12 (DN 150 to (DN 300))**, shall be one of the following:
1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
 2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 3. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 4. Stainless-steel Schedule 10 or Schedule 40 pipe, grooved-joint fittings, and grooved joints.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball or gate valves for piping **NPS 2 (DN 50)** and smaller. Use butterfly, ball, or gate valves with flanged ends for piping **NPS 2-1/2 (DN 65)** and larger.
 2. Throttling Duty: Use ball or globe valves for piping **NPS 2 (DN 50)** and smaller. Use butterfly or ball valves with flanged ends for piping **NPS 2-1/2 (DN 65)** and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 221119 – DOMESTIC WATER
PIPING SPECIALTIES

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. Backflow preventers.
 - 2. Water pressure-reducing valves.
 - 3. Strainers.
 - 4. Drain valves.
 - 5. Water meters.
- B. Related Requirements:
 - 1. Section 15126 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Section 15140 "Domestic Water Piping" for water meters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. 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 domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: **125 psig (860 kP)** unless otherwise indicated.

2.3 BACKFLOW PREVENTERS

- A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Honeywell International Inc.
 - e. Legend Valve.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
3. Standard: ASSE 1012.
4. Operation: Continuous-pressure applications.
5. Size: **NPS 1/2 (DN 15)** or **NPS 3/4 (DN 20)**.
6. Body: Bronze.
7. End Connections: Union or solder joint.
8. Finish: Chrome plated or Rough bronze.

- B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.

- d. [Flomatic Corporation.](#)
 - e. [Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.](#)
 - f. [Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.](#)
3. Standard: ASSE 1013.
 4. Operation: Continuous-pressure applications.
 5. Pressure Loss: **12 psig (83 kPa)** maximum, through middle third of flow range.
 6. Size: 1" **NPS (DN)**.
 7. Design Flow Rate: 10 **gpm (L/s)**.
 8. Selected Unit Flow Range Limits: 5-10 **gpm (L/s)**.
 9. Body: Bronze for **NPS 2 (DN 50)** and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for **NPS 2-1/2 (DN 65)** and larger.
 10. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged for **NPS 2-1/2 (DN 65)** and larger.
 11. Configuration: Designed for horizontal, straight-through, vertical-inlet, horizontal-center-section, and vertical-outlet or vertical flow.
 12. Accessories:
 - a. Valves **NPS 2 (DN 50)** and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves **NPS 2-1/2 (DN 65)** and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.](#)
 - b. [Conbraco Industries, Inc.](#)
 - c. [FEBCO; a division of Watts Water Technologies, Inc.](#)
 - d. [Flomatic Corporation.](#)
 - e. [Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.](#)
 - f. [Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.](#)
3. Standard: ASSE 1015.
4. Operation: Continuous-pressure applications unless otherwise indicated.
5. Pressure Loss: **5 psig (35 kPa)** maximum, through middle third of flow range.
6. Size: 1" **NPS (DN)**.
7. Design Flow Rate: 10 **gpm (L/s)**.
8. Selected Unit Flow Range Limits: 5-10 **gpm (L/s)**.
9. Body: Bronze for **NPS 2 (DN 50)** and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for **NPS 2-1/2 (DN 65)** and larger.

10. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged for **NPS 2-1/2 (DN 65)** and larger.
11. Configuration: Designed for horizontal, straight-through flow.
12. Accessories:
 - a. Valves **NPS 2 (DN 50)** and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves **NPS 2-1/2 (DN 65)** and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

D. Beverage-Dispensing-Equipment Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
3. Standard: ASSE 1022.
4. Operation: Continuous-pressure applications.
5. Size: **NPS 1/4 or NPS 3/8 (DN 8 or DN 10)**.
6. Body: Stainless steel.
7. End Connections: Threaded.

E. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on **Drawings** or comparable product by one of the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Ford Meter Box Company, Inc. (The).
 - f. Honeywell International Inc.
 - g. Legend Valve.
 - h. McDonald, A. Y. Mfg. Co.
 - i. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
3. Standard: ASSE 1024.
4. Operation: Continuous-pressure applications.
5. Size: [**NPS 1/2 (DN 15)**] [**NPS 3/4 (DN 20)**] [**NPS 1 (DN 25)**] [**NPS 1-1/4 (DN 32)**].

6. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Lancer Corporation.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
3. Standard: ASSE 1032.
4. Operation: Continuous-pressure applications.
5. Size: **NPS 1/4 or NPS 3/8 (DN 8 or DN 10).**
6. Body: Stainless steel.
7. End Connections: Threaded.

G. Double-Check, Detector-Assembly Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
3. Standard: ASSE 1048 and is FM Global approved or UL listed.
4. Operation: Continuous-pressure applications.
5. Pressure Loss: **5 psig (35 kPa)** maximum, through middle third of flow range.
6. Size: 1" **NPS (DN).**
7. Design Flow Rate: 10 **gpm (L/s).**
8. Selected Unit Flow Range Limits: 5-10 **gpm (L/s).**
9. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved, Steel with interior lining that complies with AWWA C550 or that is FDA approved or Stainless steel.
10. End Connections: Flanged.
11. Configuration: Designed for horizontal, straight-through, vertical-inlet, horizontal-center-section, and vertical-outlet flow.
12. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

H. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; a division of Watts Water Technologies, Inc.
 - c. Flomatic Corporation.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
3. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.4 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. Honeywell International Inc.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - e. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
3. Standard: ASSE 1003.
4. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
5. Size: 1" NPS (DN).
6. Design Flow Rate: 10 gpm (L/s).
7. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
8. Valves for Booster Heater Water Supply: Include integral bypass.
9. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

2.5 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Corporation; Bell & Gossett Div.
 - d. NIBCO Inc.
 - e. TAC.
 - f. TACO Incorporated.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
3. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
4. Body: Brass or bronze.
5. Size: Same as connected piping, but not larger than **NPS 2 (DN 50)**.
6. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Corporation; Bell & Gossett Div.
 - d. NIBCO Inc.
 - e. TAC.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
3. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
4. Size: Same as connected piping, but not smaller than **NPS 2-1/2 (DN 65)**.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.

- c. [Crane Co.; Crane Valve Group; Jenkins Valves.](#)
 - d. [Crane Co.; Crane Valve Group; Stockham Div.](#)
 - e. [Hammond Valve.](#)
 - f. [Milwaukee Valve Company.](#)
 - g. [NIBCO Inc.](#)
 - h. [Red-White Valve Corp.](#)
3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 4. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
 5. Size: NPS 2 (DN 50) or smaller.
 6. Body: Copper alloy.
 7. Port: Standard or full port.
 8. Ball: Chrome-plated brass.
 9. Seats and Seals: Replaceable.
 10. End Connections: Solder joint or threaded.
 11. Handle: Vinyl-covered steel with memory-setting device.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm), 0.033 inch (0.84 mm) or 0.062 inch (1.57 mm).
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm), 0.062 inch (1.57 mm) or 0.125 inch (3.18 mm).
 - c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm), 0.125 inch (3.18 mm) or 0.25 inch (6.35 mm).
6. Drain: Pipe plug, Factory-installed, hose-end drain valve.

2.7 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.

7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: **NPS 3/4** (DN 20).
4. Body: ASTM B 62 bronze.
5. Inlet: **NPS 3/4** (DN 20) threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: **200-psig** (1380-kPa) minimum CWP or Class 125.
3. Size: **NPS 3/4** (DN 20).
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: **NPS 1/8** (DN 6) side outlet with cap.

2.8 WATER METERS

A. Displacement-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AALIAN; a Venture Measurement product line.ABB.Badger Meter, Inc.
 - b. Carlson Meter.
 - c. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - d. Schlumberger Limited; Water Services.
 - e. Sensus.
3. Description:
 - a. Standard: AWWA C700.
 - b. Pressure Rating: **150-psig** (1035-kPa) working pressure.
 - c. Body Design: Nutating disc; totalization meter.
 - d. Registration: In **gallons** (liters) or **cubic feet** (cubic meters) as required by utility company.
 - e. Case: Bronze.
 - f. End Connections: Threaded.

B. Turbine-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AALIANT; a Venture Measurement product line.
 - b. ABB.
 - c. Badger Meter, Inc.
 - d. Hays Fluid Controls.
 - e. Master Meter, Inc.
 - f. McCrometer, Inc.
 - g. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - h. Schlumberger Limited; Water Services.
 - i. SeaMetrics Inc.
 - j. Sensus.
3. Description:
 - a. Standard: AWWA C701.
 - b. Pressure Rating: **150-psig (1035-kPa)** working pressure.
 - c. Body Design: Turbine; totalization meter.
 - d. Registration: In **gallons (liters)** or **cubic feet (cubic meters)** as required by utility company.
 - e. Case: Bronze.
 - f. End Connections for Meters **NPS 2 (DN 50)** and Smaller: Threaded.
 - g. End Connections for Meters **NPS 2-1/2 (DN 65)** and Larger: Flanged.

C. Compound-Type Water Meters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - a. ABB.
 - b. Badger Meter, Inc.
 - c. Master Meter, Inc.
 - d. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - e. Schlumberger Limited; Water Services.
 - f. Sensus.
3. Description:
 - a. Standard: AWWA C702.
 - b. Pressure Rating: **150-psig (1035-kPa)** working pressure.
 - c. Body Design: With integral mainline and bypass meters; totalization meter.
 - d. Registration: In **gallons (liters)** or **cubic feet (cubic meters)** as required by utility company.
 - e. Case: Bronze.

f. Pipe Connections: Flanged.

- D. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.
- E. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve and pump.
- G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06100 "Rough Carpentry."
- H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement

between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 06100 "Rough Carpentry."

- I. Install ground hydrants with **1 cu. yd. (0.75 cu. m)** of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- J. Install draining-type post hydrants with **1 cu. yd. (0.75 cu. m)** of crushed gravel around drain hole. Set post hydrants in concrete paving or in **1 cu. ft. (0.03 cu. m)** of concrete block at grade.
- K. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.
- L. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.
- M. Install water-hammer arresters in water piping according to PDI-WH 201.
- N. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.
- O. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- P. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- Q. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 16060 "Grounding and Bonding."
- B. Fire-retardant-treated-wood blocking is specified in Section 16120 "Conductors and Cables" for electrical connections.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check, backflow-prevention assemblies.
 - 5. Carbonated-beverage-machine backflow preventers.
 - 6. Dual-check-valve backflow preventers.
 - 7. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.

8. Double-check, detector-assembly backflow preventers.
9. Water pressure-reducing valves.
10. Calibrated balancing valves.
11. Primary, thermostatic, water mixing valves.
12. Manifold, thermostatic, water mixing-valve assemblies.
13. Photographic-process, thermostatic, water mixing-valve assemblies.
14. Primary water tempering valves.
15. Outlet boxes.
16. Hose stations.
17. Supply-type, trap-seal primer valves.
18. Trap-seal primer systems.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 15076 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 221316 – SANITARY, WASTE
AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:

1. Section 02530 "Sanitary Sewerage" for sanitary sewerage piping and structures outside the building.
2. Section 1544 "Sump Pumps" for effluent and sewage pumps.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: **10-foot head of water (30 kPa)**.
2. Waste, Force-Main Piping: **50 psig (345 kPa), 100 psig (690 kPa) or 150 psig (1035 kPa)**.

- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

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 solvent drainage system. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, 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. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 1. Notify Architect, Construction Manager or Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
 2. Do not proceed with interruption of sanitary waste service without Architect's, Construction Manager's or Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.
 - g. Stant.
 - h. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Stant.
 - g. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. MG Piping Products Company.
2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight class. Include square-cut-grooved or threaded ends matching joining method.
- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- C. Steel Pipe Pressure Fittings:
 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Cast-Iron Flanges: ASME B16.1, Class 125.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, **1/8-inch (3.2-mm)** maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- E. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International; a subsidiary of Mueller Water Products, Inc.
 - b. Grinnell Mechanical Products.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.

2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.5 STAINLESS-STEEL PIPE AND FITTINGS

- A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.
- B. Internal Sealing Rings: Elastomeric gaskets shaped to fit socket groove.

2.6 DUCTILE-IRON PIPE AND FITTINGS

- A. Ductile-Iron, Mechanical-Joint Piping:
 1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
 3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Ductile-Iron, Push-on-Joint Piping:
 1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
 3. Gaskets: AWWA C111/A21.11, rubber.
- C. Ductile-Iron, Grooved-Joint Piping:
 1. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
 2. Ductile-Iron-Pipe Appurtenances:
 - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) [Anvil International.](#)
 - 2) [Shurjoint Piping Products.](#)
 - 3) [Star Pipe Products.](#)
 - 4) [Victaulic Company.](#)

- b. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.
- c. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.7 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M (ASTM B 88M, Type B and Type C), water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.
- E. Copper Pressure Fittings:
 - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.8 ABS PIPE AND FITTINGS

- A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
- B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
- C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- D. Solvent Cement: ASTM D 2235.
 - 1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Solvent cement 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."

2.9 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Solvent Cement: ASTM D 2564.
 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Solvent cement 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."

2.10 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 3. Unshielded, Nonpressure Transition Couplings:
 - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

- b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
5. Pressure Transition Couplings:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.
 - 4) JCM Industries, Inc.
 - 5) Romac Industries, Inc.
 - 6) Smith-Blair, Inc.; a Sensus company.
 - 7) The Ford Meter Box Company, Inc.
 - 8) Viking Johnson.
 - b. Standard: AWWA C219.
 - c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - d. Center-Sleeve Material: Manufacturer's standard, Carbon steel, Stainless steel, Ductile iron or Malleable iron.
 - e. Gasket Material: Natural or synthetic rubber.
 - f. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
 - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) [Capitol Manufacturing Company.](#)
 - 2) [Central Plastics Company.](#)
 - 3) [Hart Industries International, Inc.](#)
 - 4) [Jomar International Ltd.](#)
 - 5) [Matco-Norca, Inc.](#)
 - 6) [McDonald, A. Y. Mfg. Co.](#)
 - 7) [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)
 - 8) [Wilkins; a Zurn company.](#)
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: **125 psig (860 kPa)** minimum at **180 deg F (82 deg C) 150 psig (1035 kPa)** or **250 psig (1725 kPa)**.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
 - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) [Capitol Manufacturing Company.](#)
 - 2) [Central Plastics Company.](#)
 - 3) [Matco-Norca, Inc.](#)
 - 4) [Watts Regulator Co.; a division of Watts Water Technologies, Inc.](#)
 - 5) [Wilkins; a Zurn company.](#)
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: **125 psig (860 kPa)** minimum at **180 deg F (82 deg C) 150 psig (1035 kPa), 175 psig (1200 kPa)** or **300 psig (2070 kPa)**.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:

- a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- 1) Advance Products & Systems, Inc.
- 2) Calpico, Inc.
- 3) Central Plastics Company.
- 4) Pipeline Seal and Insulator, Inc.

- b. Description:

- 1) Nonconducting materials for field assembly of companion flanges.
- 2) Pressure Rating: **150 psig (1035 kPa)**.
- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

- a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- 1) Elster Perfection.
- 2) Grinnell Mechanical Products.
- 3) Matco-Norca, Inc.
- 4) Precision Plumbing Products, Inc.
- 5) Victaulic Company.

- b. Description:

- 1) Standard: IAPMO PS 66
- 2) Electroplated steel nipple.
- 3) Pressure Rating: **300 psig (2070 kPa)** at **225 deg F (107 deg C)**.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.11 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of **0.008-inch (0.20-mm)** or high-density, cross-laminated polyethylene film of **0.004-inch (0.10-mm)** minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 02300 "Earthwork."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 15073 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping

upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping **NPS 3 (DN 80)** and smaller; 1 percent or 2 percent downward in direction of flow for piping **NPS 4 (DN 100)** and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- O. Install steel piping according to applicable plumbing code.
- P. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.
- Q. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- R. Install aboveground ABS piping according to ASTM D 2661.
- S. Install aboveground PVC piping according to ASTM D 2665.
- T. Install underground ABS and PVC piping according to ASTM D 2321.
- U. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- V. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- W. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- X. Install force mains at elevations indicated.

Y. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 15155 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 15155 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 15155 "Sanitary Waste Piping Specialties."

Z. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

AA. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."

BB. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."

CC. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15097 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

- F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

- 1. Install transition couplings at joints of piping with small differences in OD's.
- 2. In Drainage Piping: Unshielded, Shielded, nonpressure transition couplings.
- 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
- 4. In Underground Force Main Piping:
 - a. **NPS 1-1/2 (DN 40)** and Smaller: Fitting-type transition couplings.
 - b. **NPS 2 (DN 50)** and Larger: Pressure transition couplings.

B. Dielectric Fittings:

- 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- 2. Dielectric Fittings for **NPS 2 (DN 50)** and Smaller: Use dielectric nipples, unions.
- 3. Dielectric Fittings for **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Use dielectric flanges, flange kits, nipples.
- 4. Dielectric Fittings for **NPS 5 (DN 125)** and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Section 15111 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
 - 1. Install shutoff valve on each sewage pump discharge.
 - 2. Install gate or full-port ball valve for piping **NPS 2 (DN 50)** and smaller.

3. Install gate valve for piping **NPS 2-1/2 (DN 65)** and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 3. Install backwater valves in accessible locations.
 4. Comply with requirements for backwater valve specified in Section 15155 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 15073 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 15061 "Hangers and Supports for Plumbing Piping and Equipment."
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless-steel fiberglass pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. **100 Feet (30 m)** and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than **100 Feet (30 m)**: MSS Type 43, adjustable roller hangers.
 - c. Longer Than **100 Feet (30 m)** if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs **100 Feet (30 m)** or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within **12 inches (300 mm)** of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with **3/8-inch (10-mm)** minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 7. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 8. NPS 10 and NPS 12 (DN 250 and DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- I. Install supports for vertical steel piping every 15 feet (4.5 m).
- J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2 (DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 96 inches (2400 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 (DN 100): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 4. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
- K. Install supports for vertical stainless-steel piping every 10 feet (3 m).
- L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 4. NPS 3 and NPS 5 (DN 80 and DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- M. Install supports for vertical copper tubing every 10 feet (3 m).

- N. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- O. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).
- P. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves with cleanout cover flush with floor, in pit with pit cover flush with floor.
 6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 15155 "Sanitary Waste Piping Specialties."
 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Connect force-main piping to the following:
1. Sanitary Sewer: To exterior force main.
 2. Sewage Pump: To sewage pump discharge.

- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:
 1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 15076 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than **10-foot head of water (30 kPa)**. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of **1-inch wg (250 Pa)**. Use U-tube or manometer

- inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of **50 psig (345 kPa)** above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping **NPS 4 (DN 100)** and smaller shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings CISPI, heavy-duty hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
 5. Copper DWV tube, copper drainage fittings, and soldered joints.
 6. Solid-wall, Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
 7. Solid-wall, Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.

8. Dissimilar Pipe-Material Couplings: Unshielded, Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping **NPS 5 (DN 125)** and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
 5. Solid-wall, Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Dissimilar Pipe-Material Couplings: Unshielded, Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping **NPS 4 (DN 100)** and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Stainless-steel pipe and fittings gaskets, and gasketed joints.
 5. Copper DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, **NPS 2-1/2 and NPS 3-1/2 (DN 65 and DN 90)**: Hard copper tube, **Type M (Type C)**; copper pressure fittings; and soldered joints.
 6. Solid-wall, Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
 7. Solid-wall, Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 8. Dissimilar Pipe-Material Couplings: Unshielded, Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping **NPS 5 (DN 125)** and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Solid-wall, Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Unshielded, Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping **NPS 4 (DN 100)** and smaller shall be any of the following:
1. Extra Heavy, Service class, cast-iron soil piping; gaskets; and gasketed, calking materials; and calked joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron hubless-piping couplings; and coupled joints.
 3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
 4. Solid wall, Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.

5. Solid wall, Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Dissimilar Pipe-Material Couplings: Unshielded, Shielded, nonpressure transition couplings.
- G. Underground, soil and waste piping **NPS 5 (DN 125)** and larger shall be any of the following:
1. Extra Heavy Service class, cast-iron soil piping; gaskets; and gasketed calking materials; and calked joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron hubless-piping couplings; coupled joints.
 3. Solid-wall, Cellular-core PVC pipe; PVC socket fittings; and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Unshielded, Shielded, nonpressure transition couplings.
- H. Aboveground sanitary-sewage force mains **NPS 1-1/2 and NPS 2 (DN 40 and DN 50)** shall be any of the following:
1. Hard copper tube, **Type L (Type B)**; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
- I. Aboveground sanitary-sewage force mains **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)** shall be any of the following:
1. Hard copper tube, **Type L (Type B)**; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
- J. Underground sanitary-sewage force mains **NPS 4 (DN 100)** and smaller shall be any of the following:
1. Hard or Soft copper tube, **Type L (Type B)**; wrought-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Fitting-type transition coupling for piping smaller than **NPS 1-1/2 (DN 40)** and pressure transition coupling for **NPS 1-1/2 (DN 40)** and larger if dissimilar pipe materials.
- K. Underground sanitary-sewage force mains **NPS 5 (DN 125)** and larger shall be any of the following:
1. Hard copper tube, **Type L (Type B)**; wrought-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 221316

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 221319 – SANITARY, WASTE
PIPING SPECIALTIES

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. Cleanouts.
 - 2. Floor drains.
 - 3. Through-penetration firestop assemblies.
 - 4. Miscellaneous sanitary drainage piping specialties.
 - 5. Flashing materials.
 - 6. Oil interceptors.
- B. Related Requirements:
 - 1. Section 02630 "Storm Drainage" for storm drainage piping and piping specialties outside the building.
 - 2. Section 15165 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. FOG disposal systems.
 - 2. Grease interceptors.
 - 3. Grease removal devices.
 - 4. Oil interceptors.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that **oil interceptors**, accessories, and components will withstand seismic forces defined in Section 15073 "Vibration and Seismic Controls for Plumbing Piping and Equipment." 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. 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."
 - 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. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

- 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 NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03300 "Cast-in-Place Concrete." Section 03301 "Miscellaneous Cast-in-Place Concrete."
- B. Coordinate size and location of roof penetrations.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cultures: Provide 1-gal. (3.8-L) bottles of bacteria culture recommended by manufacturer of FOG disposal systems equal to 200 percent of amount installed, but no fewer than 2 1-gal. (3.8-L) bottles.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
 - 1. ASME A112.36.2M, Cast-Iron Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1) Josam Company.
 - 2) MIFAB, Inc.
 - 3) Smith, Jay R. Mfg. Co.
 - 4) Tyler Pipe.
 - 5) Watts Drainage Products.
 - 6) Zurn Plumbing Products Group.
 - 2. ASME A112.3.1, Stainless-Steel Cleanouts:

- a. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1) Josam Company.
 - 3. Standard: ASME A112.36.2M for cast iron, ASME A112.3.1 for stainless steel for cleanout test tee.
 - 4. Size: Same as connected drainage piping
 - 5. Body Material: Hubless, cast-iron soil pipe test tee with side cleanout as required to match connected piping.
 - 6. Closure: cast-iron or plastic plug.
 - 7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 8. Closure: Stainless-steel plug with seal.
- B. Metal Floor Cleanouts:
- 1. ASME A112.36.2M, Cast-Iron Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1) Josam Company.
 - 2) Oatey.
 - 3) Sioux Chief Manufacturing Co., Inc.
 - 4) Smith, Jay R. Mfg. Co.
 - 5) Tyler Pipe.
 - 6) Watts Drainage Products.
 - 7) Zurn Plumbing Products Group.
 - 2. ASME A112.36.2M, Stainless-Steel Cleanouts:
 - a. Manufacturers: Subject to compliance with requirements, products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1) Josam Company.
 - 2) Kusel Equipment Co.
 - 3) Smith, Jay R. Mfg. Co.
 - 3. ASME A112.3.1, Stainless-Steel Cleanouts:

- a. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
- b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- 1) Josam Company.

- 4. Standard: ASME A112.36.2M for adjustable housing cast-iron soil pipe with cast-iron ferrule, heavy-duty, adjustable housing, threaded, adjustable housing cleanout.
- 5. Size: Same as connected branch.
- 6. Type: Adjustable housing, Cast-iron soil pipe with cast-iron ferrule, Heavy-duty, adjustable housing or Threaded, adjustable housing.
- 7. Body or Ferrule: Cast iron, Stainless steel.
- 8. Clamping Device: Required.
- 9. Outlet Connection: Inside calk, Spigot or Threaded.
- 10. Closure: Brass plug with straight threads and gasket, Brass plug with tapered threads, Cast-iron plug or Plastic plug.
- 11. Adjustable Housing Material: Cast iron, Plastic with threads, set-screws or other device.
- 12. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, Painted cast iron, Polished bronze, Rough bronze or Stainless steel.
- 13. Frame and Cover Shape: Round or Square.
- 14. Top Loading Classification: Extra Heavy, Heavy, Light or Medium Duty.
- 15. Riser: ASTM A 74, Extra-Heavy, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- 16. Standard: ASME A112.3.1.
- 17. Size: Same as connected branch.
- 18. Housing: Stainless steel.
- 19. Closure: Stainless steel with seal.
- 20. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 3. Standard: ASME A112.36.2M. Include wall access.
- 4. Size: Same as connected drainage piping.

5. Body: Hub-and-spigot, cast-iron soil pipe T-branch, Hubless, cast-iron soil pipe test tee as required to match connected piping.
6. Closure: Countersunk, Countersunk or raised-head, Raised-head, drilled-and-threaded, brass, cast-iron plug.
7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. Wall Access: Round, deep, chrome-plated bronze, flat, chrome-plated brass or stainless-steel cover plate with screw.
9. Wall Access: Round, Square, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Plastic Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
3. Size: Same as connected branch.
4. Body: PVC.
5. Closure Plug: PVC.
6. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products.
 - h. Zurn Plumbing Products Group; Light Commercial Operation, Specification Drainage Operation.

3. Standard: ASME A112.6.3 with backwater valve.
4. Pattern: Area, Floor, Sanitary drain.
5. Body Material: Gray iron.
6. Seepage Flange: Required.
7. Anchor Flange: Required.
8. Clamping Device: Required.
9. Outlet: Bottom.
10. Backwater Valve: Drain-outlet type.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Bronze, Gray iron, Nickel bronze or Stainless steel.
13. Top of Body and Strainer Finish: Nickel bronze, polished bronze, Rough bronze or Stainless steel.
14. Top Shape: Round or square.
15. Top Loading Classification: Extra Heavy-Duty.
16. Funnel: Not required.
17. Inlet Fitting: Not required.
18. Trap Material: Not required.
19. Trap Pattern: Not required.
20. Trap Features: Not required.

B. Stainless-Steel Floor Drains:

1. ASME A112.3.1, Stainless-Steel Floor Drains:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1) Josam Company.
2. ASME A112.6.3, Stainless-Steel Floor Drains:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1) Josam Company.
 - 2) Kusel Equipment Co.
 - 3) Scherping Systems, Inc.
 - 4) Smith, Jay R. Mfg. Co.
 - 5) Tyler Pipe.
 - 6) Watts Drainage Products.
 - 7) Zurn Plumbing Products Group.
3. Standard: ASME A112.3.1, ASME A112.6.3.
4. Outlet: Bottom.

5. Top or Strainer Material: Stainless steel.
6. Top Shape: Round or Square.
7. Seepage Flange: Required.
8. Anchor Flange: Required.
9. Clamping Device: Required.
10. Trap-Primer Connection: Not required.
11. Trap Material: Not required.
12. Trap Pattern: Not required.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
3. Description: Manufactured assembly made of **4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-), 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch- (2.4-mm-)** thick, lead flashing collar and skirt extending at least **6 inches (150 mm), 8 inches (200 mm), 10 inches (250 mm)** from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. ProSet Systems Inc.
3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
4. Size: Same as connected soil, waste, or vent stack.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping **with increaser fitting of size indicated.**

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. **NPS 2 (DN 50): 4-inch- (100-mm-)** minimum water seal.
 - b. **NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-)** minimum water seal.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend **1 inch (25 mm)** or **2 inches (51 mm)** above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.6 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
 2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness).
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.7 OIL INTERCEPTORS

- A. Oil Interceptors:
1. Cast-Iron or Steel Oil Interceptors:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - b. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1) Applied Chemical Technology, Incorporated.
 - 2) Josam Company.
 - 3) MIFAB, Inc.
 - 4) Rockford Sanitary Systems, Inc.
 - 5) Schier Products Company.
 - 6) Smith, Jay R. Mfg. Co.
 - 7) Tyler Pipe.
 - 8) Watts Drainage Products.
 - 9) Zurn Plumbing Products Group.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation and seismic control devices specified in Section 15073 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
 - 2. Comply with requirements for vibration isolation devices specified in Section 15078 "Vibration Controls for Plumbing Piping and Equipment."
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to **NPS 4 (DN 100)**. Use **NPS 4 (DN 100)** for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of **50 feet (15 m)** for piping **NPS 4 (DN 100)** and smaller and **100 feet (30 m)** for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, **30 Inches (750 mm)** or Less: Equivalent to 1 percent slope, but not less than **1/4-inch (6.35-mm)** total depression.
 - b. Radius, **30 to 60 Inches (750 to 1500 mm)**: Equivalent to 1 percent slope.
 - c. Radius, **60 Inches (1500 mm)** or Larger: Equivalent to 1 percent slope, but not greater than **1-inch (25-mm)** total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- I. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- J. Assemble open drain fittings and install with top of hub **1 inch (25 mm)** or **2 inches (51 mm)** above floor.
- K. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- M. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- N. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Section 15192 "Facility Fuel-Oil Piping."
- O. Install wood-blocking reinforcement for wall-mounting-type specialties.

3.2 CONNECTIONS

- A. Comply with requirements in Section 15150 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
- D. Ground equipment according to Section 16060 "Grounding and Bonding."
- E. Connect wiring according to Section 16120 "Conductors and Cables."

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets **6.0-lb/sq. ft. (30-kg/sq. m)**, **0.0938-inch (2.4-mm)** thickness or thicker. Solder joints of lead sheets **4.0-lb/sq. ft. (20-kg/sq. m)**, **0.0625-inch (1.6-mm)** thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of **10 inches (250 mm)**, and skirt or flange extending at least **8 inches (200 mm)** around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least **8 inches (200 mm)** around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least **8 inches (200 mm)** around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07620 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Oil interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 15076 "Identification for Plumbing Piping and Equipment."

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 field-assembled oil interceptors and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain oil interceptors. Refer to Section 01820 "Demonstration and Training."

END OF SECTION 221319

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 221413 – STORM
DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:

1. Section 02630 "Storm Drainage" for storm drainage piping outside the building.
2. Section 15446 "Sump Pumps" for storm drainage pumps.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 1. Storm Drainage Piping: **10-foot head of water (30 kPa)**.
 2. Storm Drainage, Force-Main Piping: **50 psig (345 kPa), 100 psig (690 kPa) or 150 psig (1035 kPa)**.
- B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For controlled-flow roof drainage system. Include calculations, plans, and details.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For storm drainage piping, 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. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Architect, Construction Manager or Owner no fewer than two days in advance of proposed interruption of storm-drainage service.
 - 2. Do not proceed with interruption of storm-drainage service without Architect's, Construction Manager's or Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy classes.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. **Manufacturers:** Subject to compliance with requirements, **provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:**
 - a. [ANACO-Husky.](#)
 - b. [Dallas Specialty & Mfg. Co.](#)
 - c. [Fernco Inc.](#)
 - d. [Matco-Norca, Inc.](#)
 - e. [MIFAB, Inc.](#)
 - f. [Mission Rubber Company; a division of MCP Industries, Inc.](#)
 - g. [Stant.](#)
 - h. [Tyler Pipe.](#)
2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. [ANACO-Husky.](#)
 - b. [Clamp-All Corp.](#)
 - c. [Dallas Specialty & Mfg. Co.](#)
 - d. [MIFAB, Inc.](#)
 - e. [Mission Rubber Company; a division of MCP Industries, Inc.](#)
 - f. [Stant.](#)
 - g. [Tyler Pipe.](#)
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

1. **Manufacturers:** Subject to compliance with requirements, provide products by the of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [MG Piping Products Company.](#)
2. Standard: ASTM C 1277.

3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Standard Weight. Include square-cut-grooved or threaded ends matching joining method.
- B. Galvanized-Cast-Iron Drainage Fittings: ASME B16.12 threaded.
- C. Steel-Pipe Pressure Fittings:
 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Cast-Iron Flanges: ASME B16.1, Class 125.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, **1/8-inch (3.2-mm)** maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- E. Grooved-Joint, Galvanized-Steel-Pipe Appurtenances:
 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International.
 - b. Grinnell Mechanical Products.
 - c. Shurjoint Piping Products.
 - d. Victaulic Company.
 2. Galvanized, Grooved-End Fittings for Galvanized-Steel Piping: ASTM A 536 ductile-iron castings, ASTM A 47/A 47M malleable-iron castings, ASTM A 234/A 234M forged-steel fittings, or ASTM A 106/A 106M steel pipes with dimensions matching ASTM A 53/A 53M steel pipe, and complying with AWWA C606 for grooved ends.
 3. Grooved Mechanical Couplings for Galvanized-Steel Piping: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber gasket suitable for hot and cold water; and bolts and nuts.

2.5 DUCTILE-IRON PIPE AND FITTINGS

- A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Push-On-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Gaskets: AWWA C111/A21.11, rubber.

C. Ductile-Iron, Grooved-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
2. Ductile-Iron-Pipe Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Star Pipe Products.
 - 4) Victaulic Company.
 - b. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings with dimensions matching AWWA C110/A21.10 ductile-iron pipe or AWWA C153/A21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.
 - c. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.6 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast-copper fittings or ASME B16.29, wrought-copper, solder-joint fittings.
- C. Hard Copper Tube: **ASTM B 88, Type L** (**ASTM B 88M, Type B**), water tube, drawn temper.
- D. Soft Copper Tube: **ASTM B 88, Type L** (**ASTM B 88M, Type B**), water tube, annealed temper.

E. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy fittings or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.7 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

D. Solvent Cement: ASTM D 2235.

1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement 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."

2.8 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement 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."

2.9 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.

- c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5. Pressure Transition Couplings:

- a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.
 - 4) Ford Meter Box Company, Inc. (The)
 - 5) JCM Industries, Inc.
 - 6) Romac Industries, Inc.
 - 7) Smith-Blair, Inc.; a Sensus company.
 - 8) Viking Johnson; c/o Mueller Co.
- b. Standard: AWWA C219.
- c. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
- d. Center-Sleeve Material: Manufacturer's standard, Carbon steel Stainless steel, Ductile iron or Malleable iron.
- e. Gasket Material: Natural or synthetic rubber.
- f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
 - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Hart Industries International, Inc.
 - 4) Jomar International Ltd.
 - 5) Matco-Norca, Inc.
 - 6) McDonald, A. Y. Mfg. Co.
 - 7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 8) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.

- 2) Pressure Rating: **150 psig (1035 kPa)** or **250 psig (1725 kPa)** at **180 deg F (82 deg C)**.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Matco-Norca, Inc.
 - 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 5) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: **150 psig (1035 kPa)**, **175 psig (1200 kPa)** minimum **300 psig (2070 kPa)**.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - 4) Pipeline Seal and Insulator, Inc.
 - b. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: **150 psig (1035 kPa)**.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel-backing washers.
5. Dielectric Nipples:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

- 1) [Elster Perfection.](#)
- 2) [Grinnell Mechanical Products.](#)
- 3) [Matco-Norca, Inc.](#)
- 4) [Precision Plumbing Products, Inc.](#)
- 5) [Victaulic Company.](#)

b. Description:

- 1) Electroplated steel nipple complying with ASTM F 1545.
- 2) Pressure Rating: **300 psig (2070 kPa)** at **225 deg F (107 deg C)**.
- 3) End Connections: Male threaded or grooved.
- 4) Lining: Inert and noncorrosive, propylene.

2.10 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: High-density, crosslaminated PE film of **0.004-inch (0.10-mm)** or LLDPE film of **0.008-inch (0.20-mm)** minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 02300 "Earthwork."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 15073 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- M. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Storm Drain: 1 percent or 2 percent downward in direction of flow for piping **NPS 3 (DN 80)** and smaller; 1 percent or 2 percent downward in direction of flow for piping **NPS 4 (DN 100)** and larger.
 - 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- O. Install steel piping according to applicable plumbing code.
- P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- Q. Install aboveground ABS piping according to ASTM D 2661.
- R. Install aboveground PVC piping according to ASTM D 2665.
- S. Install underground ABS and PVC piping according to ASTM D 2321.
- T. Install engineered controlled-flow drain specialties and storm drainage piping in locations indicated.

- U. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- V. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- W. Install force mains at elevations indicated.
- X. Plumbing Specialties:
 - 1. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Section 15165 "Storm Drainage Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 15165 "Storm Drainage Piping Specialties."
 - 3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 15165 "Storm Drainage Piping Specialties."
- Y. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Z. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."
- AA. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."
- BB. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15097 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Join copper tube and fittings with soldered joints according to ASTM B 828 procedure. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- F. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- G. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- H. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Unshielded or Shielded, nonpressure transition couplings.
 - 3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force-Main Piping:
 - a. **NPS 1-1/2 (DN 40)** and Smaller: Fitting-type transition couplings.
 - b. **NPS 2 (DN 50)** and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for **NPS 2 (DN 50)** and Smaller: Use dielectric nipples, unions.
 - 3. Dielectric Fittings for **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Use dielectric flanges , flange kits, nipples.
 - 4. Dielectric Fittings for **NPS 5 (DN 125)** and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Section 15111 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sump pump discharge.
 - 1. Install gate or full-port ball valve for piping **NPS 2 (DN 50)** and smaller.
 - 2. Install gate valve for piping **NPS 2-1/2 (DN 65)** and larger.
- C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves.[**Use normally closed type unless otherwise indicated.**]
 - 2. Install backwater valves in accessible locations.
 - 3. Comply with requirements for backwater valves specified in Section 15165 "Storm Drainage Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 15073 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 15061 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel or fiberglass pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 6. Individual, Straight, Horizontal Piping Runs:
 - a. **100 Feet (30 m)** and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than **100 Feet (30 m)**: MSS Type 43, adjustable roller hangers.
 - c. Longer Than **100 Feet (30 m)** if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs **100 Feet (30 m)** or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within **12 inches (300 mm)** of each fitting[, valve,] and coupling.
- D. Support vertical piping and tubing at base and at each floor.

- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 - 6. Spacing for 10-foot (3-m) pipe lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 6 and NPS 8 (DN 150 and DN 200): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - 8. NPS 10 and NPS 12 (DN 250 and DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- I. Install supports for vertical steel piping every 15 feet (4.5 m).
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - 4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - 5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - 6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
- K. Install supports for vertical copper tubing every 10 feet (3 m).
- L. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

- M. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).
- N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 2. Install horizontal backwater valves with cleanout cover flush with floor, in pit with pit cover flush with floor.
 3. Comply with requirements for backwater valves, cleanouts and drains specified in Section 15165 "Storm Drainage Piping Specialties."
- D. Connect force-main piping to the following:
1. Storm Sewer: To exterior force main.
 2. Sump Pumps: To sump pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 15076 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.10 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping **NPS 6 (DN 150)** and smaller shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Copper DWV tube, copper drainage fittings, and soldered joints.
 5. Solid-wall, Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
 6. Solid-wall, Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 7. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- C. Underground storm drainage piping **NPS 6 (DN 150)** and smaller shall be any of the following:
 1. Extra Heavy Service class, cast-iron soil pipe and fittings; gaskets; and gasketed, calking materials; and calked joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.
 3. Solid-wall, Cellular-core ABS pipe, ABS socket fittings, and solvent-cemented joints.
 4. Solid-wall, Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- D. Underground, storm drainage piping **NPS 8 (DN 200)** and larger shall be any of the following:
 1. Extra Heavy, Service] class, cast-iron soil pipe and fittings; gaskets; and gasketed calking materials; and calked joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.
 3. Solid-wall, Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-cemented joints.

5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- E. Aboveground storm drainage force mains **NPS 1-1/2 and NPS 2 (DN 40 and DN 50)** shall be any of the following:
1. Hard copper tube, copper pressure fittings, and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
- F. Aboveground storm drainage force mains **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)** shall be any of the following:
1. Hard copper tube, copper pressure fittings, and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 4. Fitting-type transition couplings if dissimilar pipe materials.
- G. Underground storm drainage force mains **NPS 4 (DN 100)** and smaller shall be any of the following:
1. Hard or Soft copper tube; wrought-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Fitting-type transition coupling for piping smaller than **NPS 1-1/2 (DN 40)** and pressure transition coupling for **NPS 1-1/2 (DN 40)** and larger if dissimilar pipe materials.
- H. Underground storm drainage force mains **NPS 5 (DN 125)** and larger shall be any of the following:
1. Hard copper tube; wrought-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION221413

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 221423 – STORM DRAINAGE
PIPING SPECIALTIES

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. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Backwater valves.
5. Through-penetration firestop assemblies.
6. Flashing materials.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

- A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. [Josam Company.](#)
 - b. [Marathon Roofing Products.](#)
 - c. [MIFAB, Inc.](#)
 - d. [Smith, Jay R. Mfg. Co.](#)
 - e. [Tyler Pipe.](#)
 - f. [Watts Water Technologies, Inc.](#)
 - g. [Zurn Plumbing Products Group; Specification Drainage Operation.](#)
3. Standard: ASME A112.6.4, for general-purpose roof drains.
 4. Body Material: Cast iron.
 5. Dimension of Body: Nominal 14-inch (357-mm) diameter.
 6. Combination Flashing Ring and Gravel Stop: Not required.
 7. Flow-Control Weirs: Not required.
 8. Outlet: Bottom.
 9. Extension Collars: Required.
 10. Underdeck Clamp: Required.
 11. Expansion Joint: Required.
 12. Sump Receiver Plate: Not required.
 13. Dome Material: Aluminum, cast iron, PE or Stainless steel.
 14. Perforated Gravel Guard: Stainless steel.
 15. Vandal-Proof Dome: Required.
 16. Water Dam: 2 inches (51 mm) high.

B. Cast-Iron, Medium-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 2. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Josam Company.](#)
 - b. [Marathon Roofing Products.](#)
 - c. [MIFAB, Inc.](#)
 - d. [Portals Plus; Commercial Products Group of Hart & Cooley, Inc.](#)
 - e. [Smith, Jay R. Mfg. Co.](#)
 - f. [Tyler Pipe.](#)
 - g. [Watts Water Technologies, Inc.](#)
 - h. [Zurn Plumbing Products Group; Light Commercial Products Operation.](#)
 - i. [Zurn Plumbing Products Group; Specification Drainage Operation.](#)
3. Standard: ASME A112.6.4, for general-purpose roof drains.
 4. Body Material: Cast iron.
 5. Dimension of Body: 8- to 12-inch (203- to 305-mm) diameter.
 6. Combination Flashing Ring and Gravel Stop: Not required.
 7. Flow-Control Weirs: Not required.
 8. Outlet: Bottom.
 9. Extension Collars: Required.
 10. Underdeck Clamp: Required.
 11. Expansion Joint: Required.

12. Sump Receiver Plate: Not required.
13. Dome Material: Aluminum, Cast iron, Copper, PE or Stainless steel.
14. Wire Mesh: Stainless steel or brass over dome.
15. Perforated Gravel Guard: Stainless steel.
16. Vandal-Proof Dome: Required.
17. Water Dam: 2 inches (51 mm) high.

C. Cast-Iron, Small-Sump, General-Purpose Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Marathon Roofing Products.
 - c. MIFAB, Inc.
 - d. Smith, Jay R. Mfg. Co.
 - e. Tyler Pipe.
 - f. Watts Water Technologies, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Products Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.6.4, for general-purpose roof drains.
4. Body Material: Cast iron.
5. Dimension of Body: Nominal 8-inch (203-mm) diameter.
6. Combination Flashing Ring and Gravel Stop: Not required.
7. Outlet: Bottom.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Expansion Joint: Required.
11. Sump Receiver Plate: Not required.
12. Dome Material: Cast iron.
13. Wire Mesh: Stainless steel or brass over dome.
14. Vandal-Proof Dome: Required.

D. Metal, Large-Sump, Promenade Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Standard: ASME A112.6.4, for promenade roof drains.
4. Body Material: Cast iron.
5. Dimension of Body: Nominal 14-inch (357-mm) diameter.
6. Dimension of Frame and Grate: Nominal 14 inches (357 mm) square.
7. Outlet: Bottom.
8. Grate Material: Bronze, Cast iron or Nickel-bronze alloy.
9. Vandal-Proof Grate: Required.
10. Extension Collars: Required.
11. Underdeck Clamp: Required.
12. Expansion Joint: Required.
13. Sump Receiver Plate: Not required.

E. Metal, Medium-Sump, Promenade Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.6.4, for promenade roof drains.
4. Body Material: Cast iron.
5. Dimension of Body: 11- to 12-inch (280- to 305-mm) diameter.
6. Dimension of Frame and Grate: Nominal 12 inches (305 mm) square.
7. Outlet: Bottom.
8. Grate Material: Bronze, Cast iron or Nickel-bronze alloy.
9. Vandal-Proof Grate: Required.
10. Extension Collars: Required.
11. Underdeck Clamp: Required.
12. Expansion Joint: Required.
13. Sump Receiver Plate: Not required.

F. Metal, Small-Sump, Promenade Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe.
 - d. Watts Water Technologies, Inc.

- e. [Zurn Plumbing Products Group; Light Commercial Products Operation.](#)
- f. [Zurn Plumbing Products Group; Specification Drainage Operation.](#)

- 3. Standard: ASME A112.6.4, for promenade roof drains.
- 4. Body Material: Cast iron.
- 5. Dimension of Body: Nominal **8-inch (203-mm)** diameter.
- 6. Dimension of Frame and Grate: Nominal **8 inches (203 mm)** square.
- 7. Outlet: Bottom.
- 8. Grate Material: Bronze, Cast iron or Nickel-bronze alloy.
- 9. Vandal-Proof Grate: Required.
- 10. Extension Collars: Required
- 11. Underdeck Clamp: Required
- 12. Expansion Joint: Required
- 13. Sump Receiver Plate: Not required.

G. Metal, Medium-Sump, Deck Roof Drains:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
- 2. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Josam Company.](#)
 - b. [MIFAB, Inc.](#)
 - c. [Smith, Jay R. Mfg. Co.](#)
 - d. [Tyler Pipe.](#)
 - e. [Watts Water Technologies, Inc.](#)
 - f. [Zurn Plumbing Products Group; Specification Drainage Operation.](#)
- 3. Standard: ASME A112.6.4, for deck roof drains; ASME A112.6.3, for floor drains.
- 4. Body Material: Metal.
- 5. Flange: Anchor or Anchor with weep holes.
- 6. Clamping Device: Required.
- 7. Integral Backwater Valve: Required.
- 8. Outlet: Bottom.
- 9. Grate Material: Cast iron.
- 10. Grate Finish: Painted.
- 11. Overall Dimension of Frame and Grate: Nominal **14 inches (357 mm)** round or square.
- 12. Top-Loading Classification: Heavy Duty.
- 13. Vandal-Proof Frame and Grate: Required.

H. Metal, Small-Sump, Deck Roof Drains:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
- 2. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. [Josam Company.](#)
 - b. [MIFAB, Inc.](#)
 - c. [Smith, Jay R. Mfg. Co.](#)
 - d. [Tyler Pipe.](#)
 - e. [Watts Water Technologies, Inc.](#)
 - f. [Zurn Plumbing Products Group; Specification Drainage Operation.](#)
- 3. Standard: ASME A112.6.4, for deck roof drains; ASME A112.6.3, for floor drains.
 - 4. Body Material: Metal.
 - 5. Flange: Anchor or Anchor with weep holes.
 - 6. Clamping Device: Required.
 - 7. Integral Backwater Valve: Required.
 - 8. Outlet: Bottom.
 - 9. Grate Material: Cast iron.
 - 10. Grate Finish: Painted.
 - 11. Overall Dimension of Frame and Grate: Nominal **8 inches (203 mm)** round or square.
 - 12. Top-Loading Classification: Heavy Duty.
 - 13. Vandal-Proof Frame and Grate: Required.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors:

- 1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
- 2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots:

- 1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; **NPS 4 (DN 100)** outlet; and shop-applied bituminous coating.
- 2. Size: Inlet size to match downspout and **NPS 4 (DN 100)** outlet.

C. Conductor Nozzles:

- 1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
- 2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Floor Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
- 2. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. [Josam Company.](#)
 - b. [Oatey.](#)
 - c. [Sioux Chief Manufacturing Company, Inc.](#)
 - d. [Smith, Jay R. Mfg. Co.](#)
 - e. [Tyler Pipe.](#)
 - f. [Watts Water Technologies, Inc.](#)
 - g. [Zurn Plumbing Products Group; Light Commercial Products Operation.](#)
 - h. [Zurn Plumbing Products Group; Specification Drainage Operation.](#)
- 3. Standard: ASME A112.36.2M, for adjustable housing, cast-iron soil pipe with cast-iron ferrule, heavy-duty, adjustable housing threaded or adjustable housing cleanouts.
 - 4. Size: Same as connected branch.
 - 5. Type: Adjustable housing, Cast-iron soil pipe with cast-iron ferrule, Heavy-duty, adjustable housing or Threaded, adjustable housing.
 - 6. Body or Ferrule Material: Cast iron or Stainless steel.
 - 7. Clamping Device: Required.
 - 8. Outlet Connection: Inside calk, Spigot or Threaded.
 - 9. Closure: Brass plug with straight threads and gasket, Brass plug with tapered threads, Cast-iron plug or Plastic plug.
 - 10. Adjustable Housing Material: Cast iron or Plastic with threads, set-screws or other device.
 - 11. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, Painted cast iron, Polished bronze, Rough bronze or Stainless steel.
 - 12. Frame and Cover Shape: Round or Square.
 - 13. Top-Loading Classification: Heavy Duty.
 - 14. Riser: ASTM A 74, Extra-Heavy Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
- 2. [Basis-of-Design Product:](#) Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. [Josam Company.](#)
 - b. [MIFAB, Inc.](#)
 - c. [Smith, Jay R. Mfg. Co.](#)
 - d. [Tyler Pipe.](#)
 - e. [Watts Water Technologies, Inc.](#)
 - f. [Zurn Plumbing Products Group; Specification Drainage Operation.](#)
- 3. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
- 4. Size: Same as connected drainage piping.
- 5. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
- 6. Closure Plug: Countersunk or raised head, brass.
- 7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
4. Size: Same as connected drainage piping.
5. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch, Hubless, cast-iron soil-pipe test tee as required to match connected piping.
6. Closure: Countersunk, Countersunk or raised-head, Raised-head, drilled-and-threaded, brass or cast-iron plug.
7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. Wall Access: Round, deep, chrome-plated bronze, flat, chrome-plated brass or stainless-steel cover plate with screw.
9. Wall Access: Round or Square, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Plastic Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Products Operation.
3. Size: Same as connected branch.
4. Body Material: PVC.
5. Closure Plug: PVC.
6. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.4 BACKWATER VALVES

A. Cast-Iron, Horizontal Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASME A112.14.1, for backwater valves.
4. Size: Same as connected piping.
5. Body Material: Cast iron.
6. Cover: Cast iron with bolted or threaded access check valve.
7. End Connections: Hub and spigot or hubless.
8. Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
9. Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Cast-Iron, Drain-Outlet Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Watts Water Technologies, Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Size: Same as floor drain outlet.
4. Body Material: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
5. Check Valve: Removable ball float.
6. Inlet: Threaded.
7. Outlet: Threaded or spigot.

C. Plastic, Horizontal Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Products Operation.
3. Standard: ASME A112.14.1, for backwater valves.
4. Size: Same as connected piping.
5. Body Material: ABS or PVC.
6. Cover: Same material as body with threaded access to check valve.
7. Check Valve: Removable swing check.
8. End Connections: Socket type.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturer offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. ProSet Systems Inc.
3. Standard: ASTM E 814, for through-penetration firestop assemblies.
4. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.
5. Size: Same as connected pipe.
6. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
7. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
8. Special Coating: Corrosion resistant on interior of fittings.

2.6 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, **12 oz./sq. ft.** (3.7 kg/sq. m or 0.41-mm thickness).

- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and **0.04-inch (1.01-mm)** minimum thickness unless otherwise indicated. Include **G90 (Z275)** hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, **40-mil (1.01-mm)** minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top **6 inches (152 mm)**, **12 inches (305 mm)** or **18 inches (457 mm)** above grade. Secure to building wall.
- D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
 - 1. Use cleanouts the same size as drainage piping up to **NPS 4 (DN 100)**. Use **NPS 4 (DN 100)** for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 - 3. Locate cleanouts at minimum intervals of **50 feet (15 m)** for piping **NPS 4 (DN 100)** and smaller and **100 feet (30 m)** for larger piping.
 - 4. Locate cleanouts at base of each vertical soil and waste stack.
- F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

- G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- H. Install horizontal backwater valves in floor with cover flush with floor.
- I. Install drain-outlet backwater valves in outlet of drains.
- J. Install test tees in vertical conductors and near floor.
- K. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- L. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.
- M. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 15160 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets, 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA

SECTION 221429 – SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Submersible sump pumps.
2. Wet-pit-volute sump pumps.
3. Sump-pump basins and basin covers.
4. Packaged drainage-pump units.

B. Related Section:

1. Section 15445 "Sewage Pumps" for effluent and sewage pumps.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Single-Seal Sump Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Barnes; Crane Pumps & Systems.
 - b. Bell & Gossett Domestic Pump; ITT Corporation.
 - c. Flo Fab inc.
 - d. Glentronics, Inc.
 - e. Goulds Pumps; ITT Corporation.
 - f. Grundfos Pumps Corp.
 - g. Liberty Pumps.
 - h. Little Giant Pump Co.
 - i. McDonald, A. Y. Mfg. Co.
 - j. Pentair Pump Group; Hydromatic Pumps.
 - k. Pentair Pump Group; Myers.
 - l. Stancor, Inc.
 - m. Sta-Rite Industries, Inc.
 - n. Weil Pump Company, Inc.
 - o. Weinman Division; Crane Pumps & Systems.
 - p. Zoeller Company.
3. Description: Factory-assembled and -tested sump-pump unit.
4. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
5. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
6. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron, ASTM A 532/A 532M, abrasion-resistant cast iron and ASTM B 584, cast bronze, semiopen design for clear wastewater handling, and keyed and secured to shaft.
7. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.
8. Seal: Mechanical.

9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

- a. Motor Housing Fluid: Oil.

10. Controls:

- a. Enclosure: NEMA 250, Type 1 or Type 4X.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

11. Controls:

- a. Enclosure: NEMA 250, Type 1 or Type 4X; pedestal or wall-mounted.
 - b. Switch Type: Mechanical-float, Mercury-float or Pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

12. Control-Interface Features:

- a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

B. Submersible, Fixed-Position, Double-Seal Sump Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. BJM Pumps, LLC.
 - b. EBARA Fluid Handling.
 - c. ITT Flygt Corporation.
 - d. PACO Pumps; Grundfos Pumps Corporation, U.S.A.

3. Description: Factory-assembled and -tested sump-pump unit.
4. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
5. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
6. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron, ASTM A 532/A 532M, abrasion-resistant cast iron and ASTM B 584, cast bronze, semi-open design for clear wastewater handling, and keyed and secured to shaft.
7. Pump and Motor Shaft: Stainless steel or steel, with factory-sealed, grease-lubricated ball bearings.
8. Seals: Mechanical.
9. Moisture-Sensing Probe: Internal moisture sensor and moisture alarm.
10. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: Oil.
11. Controls:
 - a. Enclosure: NEMA 250, Type 1 or Type 4X.
 - b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches (1500 mm).
 - e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
12. Controls:
 - a. Enclosure: NEMA 250, Type 1 or Type 4X; pedestal or wall-mounted.
 - b. Switch Type: Mechanical-float, Mercury-float or Pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
13. Control-Interface Features:
 - a. Remote Alarm Contacts: For remote alarm interface.
 - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - 1) On-off status of pump.
 - 2) Alarm status.

2.2 WET-PIT-VOLUTE SUMP PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Alyan Pump Company.
 - 2. Armstrong Pumps Inc.
 - 3. Chicago Pump Company; a division of Yeomans Chicago Corporation.
 - 4. Federal Pump Corp.
 - 5. Flo Fab inc.
 - 6. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
 - 7. Peerless Pump, Inc.
 - 8. Pentair Pump Group; Aurora Pump.
 - 9. Swaby Manufacturing Company.
 - 10. Tramco Pump Company.
 - 11. Vertiflo Pump Company.
 - 12. Weil Pump Company, Inc.
 - 13. Weinman Division; Crane Pumps & Systems.
 - 14. Yeomans Chicago Corporation.
- C. Description: Factory-assembled and -tested sump-pump unit.
- D. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
- E. Pump Casing: Cast iron, with strainer inlet and threaded connection for **NPS 2 (DN 50)** and smaller and flanged connection for **NPS 2-1/2 (DN 65)** and larger discharge piping.
- F. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron, ASTM A 532/A 532M, abrasion-resistant cast iron and ASTM B 584, cast bronze or semi-open design for clear wastewater handling, and keyed and secured to shaft.
- G. Sleeve Bearings: Bronze. Include oil-lubricated, intermediate sleeve bearings at **48-inch (1200-mm)** maximum intervals if basin depth is more than **48 inches (1200 mm)**, and grease-lubricated, ball-type thrust bearings.
- H. Pump and Motor Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
- I. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class 125, cast-iron flanges and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings.
- J. Support Plate: Cast iron or coated steel and strong enough to support pumps, motors, and controls. Refer to Part 2 "Sump-Pump Basins and Basin Covers" Article for requirements.

- K. Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.
- L. Motor: Single-speed; grease-lubricated ball bearings and mounting on vertical, cast-iron pedestal.
- M. Controls:
 - 1. Enclosure: NEMA 250, Type 1 or Type 4X.
 - 2. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
 - 3. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than **60 inches (1500 mm)**.
 - 5. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- N. Controls:
 - 1. Enclosure: NEMA 250, Type 1 or Type 4X; pedestal or wall-mounted.
 - 2. Switch Type: Mechanical-float, Mercury-float or Pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
 - 3. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
 - 4. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
- O. Control-Interface Features:
 - 1. Remote Alarm Contacts: For remote alarm interface.
 - 2. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
 - a. On-off status of pump.
 - b. Alarm status.

2.3 SUMP PUMP CAPACITIES AND CHARACTERISTICS

- A. Unit Capacity: See schedule.
- B. Number of Pumps: One or Two.
- C. Each Pump:
 - 1. Capacity: See schedule.
 - 2. Total Dynamic Head: See schedule.
 - 3. Speed: See schedule.
 - 4. Discharge Size: See schedule.

5. Electrical Characteristics:
 - a. Motor Horsepower: See schedule.
 - b. Volts: See schedule.
 - c. Phases: See schedule.
 - d. Hertz: 60.

D. Unit Electrical Characteristics:

1. Full-Load Amperes: See schedule.
2. Minimum Circuit Ampacity: See schedule
3. Maximum Overcurrent Protection: See schedule.

2.4 SUMP-PUMP BASINS AND BASIN COVERS

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
 1. Material: Cast iron, Fiberglass or Polyethylene].
 2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
 3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
- C. Capacities and Characteristics:
 1. Capacity: See schedule and plans.
 2. Diameter: See schedule and plans.
 3. Depth: See schedule and plans.
 4. Inlet No. 1:
 - a. Drainage Pipe Size: See schedule and plans..
 - b. Bottom of Sump to Centerline: See schedule and plans.
 - c. Type: Flanged, Hubbed or Threaded outside.
 5. Inlet No. 2:
 - a. Drainage Pipe Size: See schedule and plans.
 - b. Bottom of Sump to Centerline: See schedule and plans.
 - c. Type: Flanged, Hubbed or Threaded outside.
 6. Inlet No. 3:

- a. Drainage Pipe Size: See plumbing drawings.
 - b. Bottom of Sump to Centerline: See plumbing drawings.
 - c. Type: Flanged, Hubbed or Threaded outside.
7. Sidewall Outlet:
- a. Discharge Pipe Size: See plumbing drawings.
 - b. Bottom of Sump to Centerline: See plumbing drawings.
 - c. Type: Hubbed inside.
8. Cover Material: Cast iron, Steel with bituminous coating, Cast iron or steel with bituminous coating.
9. Cover Diameter: See plumbing drawings.
10. Manhole Required in Cover: See schedule on drawings.
11. Vent Size: See schedule on drawings.

2.5 PACKAGED DRAINAGE-PUMP UNITS

A. Packaged Pedestal Drainage-Pump Units:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. AMT; a subsidiary of the Gorman-Rupp Company.
 - b. Goulds Pumps; ITT Corporation.
 - c. Liberty Pumps.
 - d. Little Giant Pump Co.
 - e. Pentair Pump Group; Hydromatic Pumps.
 - f. Pentair Pump Group; Myers.
 - g. Sta-Rite Industries, Inc.
 - h. Zoeller Company.
- 3. Description: Factory-assembled and -tested, automatic-operation, freestanding, sump-pump unit.
- 4. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
- 5. Pump Casing: Corrosion-resistant material, with strainer inlet, design that permits flow into impeller, and vertical discharge for piping connection.
- 6. Impeller: Aluminum, brass, or plastic.
- 7. Motor: With built-in overload protection and mounted vertically on sump pump column.
- 8. Power Cord: Three-conductor, waterproof cable of length required but not less than **72 inches (1830 mm)**, with grounding plug and cable-sealing assembly for connection at pump.
- 9. Control: Float switch.

B. Packaged Submersible Drainage-Pump Units:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. ABS Pumps Inc.
 - b. Bell & Gossett Domestic Pump; ITT Corporation.
 - c. Glentronics, Inc.
 - d. Goulds Pumps; ITT Corporation.
 - e. Grundfos Pumps Corp.
 - f. Liberty Pumps.
 - g. Little Giant Pump Co.
 - h. McDonald, A. Y. Mfg. Co.
 - i. Pentair Pump Group; Hydromatic Pumps.
 - j. Pentair Pump Group; Myers.
 - k. Sta-Rite Industries, Inc.
 - l. Zoeller Company.
3. Description: Factory-assembled and -tested, automatic-operation, basin-mounted, sump-pump unit.
4. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller centrifugal pump as defined in HI 1.1-1.2 and HI 1.3.
5. Casing: Metal.
6. Impeller: Brass.
7. Pump Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection.
9. Power Cord: Three-conductor, waterproof cable of length required but not less than **72 inches (1830 mm)**, with grounding plug and cable-sealing assembly for connection at pump.
10. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.4, Class 125, gray iron threaded fittings.
11. Control: Motor-mounted float switch.
12. Basin: Plastic.

C. Capacity and Characteristics:

1. Capacity: See schedule on drawings.
2. Total Dynamic Head: See schedule on drawings.
3. Speed: See schedule on drawings.
4. Discharge Pipe Size: See schedule on drawings.
5. Electrical Characteristics:
 - a. Motor Horsepower: See schedule on drawings
 - b. Volts: See schedule on drawings
 - c. Phases: See schedule on drawings
 - d. Hertz: 60.
 - e. Full-Load Amperes: See schedule on drawings
 - f. Minimum Circuit Ampacity: See schedule on drawings
 - g. Maximum Overcurrent Protection: A.

- 6. Basin: Not Required.
- 7. Basin:
 - a. Capacity: See schedule on drawings.
 - b. Inlet Connection: See schedule on drawings.

2.6 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15057 "Common Motor Requirements for Plumbing 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.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation and filling are specified in Section 02300 "Earthwork."

3.2 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

- A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.4 CONNECTIONS

- A. Comply with requirements for piping specified in Section 15160 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.5 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. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform, Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train, Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

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**SECTION 230100 – BASIC
MECHANICAL REQUIREMENTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The mechanical systems and related components described in Division 23 Contract Documents shall be provided as complete installations that have been tested and balanced for continuous operation as specified. Items shown on the Drawings but not listed within the Specifications or the reverse of this or any other miscellaneous accessory items, required for a complete and operational system in accordance with governing jurisdictions, shall be provided at no additional cost to the Owner.
- B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this and the other sections of Division 23.
- C. "Mechanical," as used in this specification, includes all work specified under Division 23, Mechanical and HVAC specification sections.

1.2 SUMMARY

- A. This section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this section to expand the requirements specified in Division 1:
 - 1. Submittals.
 - 2. Record documents.
 - 3. Maintenance manuals.
 - 4. Delivery, storage and handling.
 - 5. Warranty and service.
 - 6. Rough-ins.
 - 7. Mechanical installations.
 - 8. Cutting and patching.

1.3 PERMITS, FEES, CODES, ORDINANCES AND REGULATIONS

- A. Obtain and pay for all permits, inspections and connection fees required by governing bodies in connection with all of the work associated with Division 23. Deliver Certificates of Inspection to the Architect.

- B. All work shall comply with governing codes, ordinances, standards, laws, and regulations of city, county and state having jurisdiction.
- C. Other than the signed and sealed Contract Documents, the Contractor is responsible for any Professional Engineer's signature and seal required by authorities having jurisdiction.
- D. ADA: Comply with the requirements of the Americans with Disabilities Act. (ADA).
- E. NFPA: Comply with the requirements of the National Fire Protection Association (NFPA) Standards and Codes and Standards adopted by local authorities having jurisdiction.
 - 1. NFPA-70, National Electrical Code, 2005 Revision.
 - 2. NFPA-90A, Standards for the Installation of Air Conditioning and Ventilation Systems, 2002 Revision.
 - 3. NFPA-90B, Standards for the Installation of Warm Air Heating and Air Conditioning Systems, 2002 Revision.
 - 4. NFPA-101, Life Safety Code, 2003 Revision.
- F. Building Codes: Comply with specific edition and the amendments enforced by the local authority having jurisdiction.
 - 1. International Building Code 2006
 - 2. International Fuel Gas Code 2006.
 - 3. International Plumbing Code 2006
 - 4. IMC 2006 with amendments (MN Mechanical Code, MN Rules Chapter 1346
 - 5. ANSI/ASHRAE 90.1-2004 Minnesota Energy Code (MN Rules Chapter 7670-7678)
- G. Contractor shall be familiar with all applicable codes and standards and conform to all applicable requirements.

1.4 DRAWINGS AND SPECIFICATIONS

- A. Design Intent: The drawings and specifications are provided to establish an acceptable minimum level of quality/standards for materials, equipment, workmanship used to provide complete (installed, tested, balanced, calibrated and controlled) operational mechanical equipment and system installations.
- B. Locating Equipment: The Contract Drawings are diagrammatic. They show general arrangements and locations of mechanical equipment and systems. The locations of each shall be established as referenced by the Contract Drawings, manufacturer's product data (physical and maintenance space requirements), clearances required by local codes, and field measurements of constructed building. If situation occurs where the installation must deviate from the Drawings due to field conditions, submit

detailed layouts of proposed departures to the Owner's Representative for written approval prior to performing the subject work. The Contractor is responsible to make his own field measurements and coordinate this work with other trades in a timely manner to minimize conflicts or delays.

- C. Duct and Pipe Routing: Due to small drawing scales and unforeseen job conditions, not all fittings are shown on the Drawings. Provide all necessary offsets, transitions, and fittings required for a complete system installation at no additional cost to Owner.
- D. Conflicts: Should a conflict occur, the Owner's Representative will provide an interpretation in accordance with the Contract Specifications, General Conditions.

1.5 SUBMITTALS

- A. General: Follow the procedures specified in Division 1, Section 01300 – SUBMITTALS and the requirements specified in Division 15 specifications. The provisions of this section are supplemental to the requirements of Division 1.
- B. Combined Shop Drawing Submittals: All shop drawing submittals of Plumbing System components (piping, insulation, valves, I.D. Labels, etc.) and equipment shall be submitted independent of HVAC related components or equipment. All submittals containing both HVAC and Plumbing system components or equipment will be rejected and returned for separation by discipline.
- C. Multiple Section Submittals: Each submittal containing multiple sections of unlike components or equipment will be rejected and returned for separation into multiple submittals of like items as defined by their appropriate Division 23 Specification Section Number.
- D. Multiple Submittals: Wherever multiple (large) or complex submittals are received by Architect/Engineer's within one to three days apart, shall retroactively extend the two-weeks review time (Section 1300) as required to suite the quantity and complexity of Shop Drawings received. The time period for reviewing Shop Drawings, received in advance of an approved Shop Drawing Submittal Schedule, may also lengthen the subject review period.
- E. Contractor Schedule of Values: In accordance with specification, submit a schedule of values that as a minimum associates a monetary value for each Division 23 specification sections. Additionally, the contractor shall identify a specific value in the schedule of values for the coordination drawings.
- F. Shop Drawing Submittal Schedule: In accordance with specifications, submit a Shop Drawing submittal schedule in advance of submitting Division 23 component, material or equipment Shop Drawings.

1.6 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1, specification section - CONTRACT CLOSEOUT. In addition to the requirements specified in Division 1, indicate the following installed conditions:

1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
 2. 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., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23, Section 230553 - MECHANICAL IDENTIFICATION. Indicate actual inverts and horizontal locations of underground piping.
 3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 4. Approved substitutions, contract modifications, and actual equipment and materials installed.
- B. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified in Division 1, specification section - FIELD ENGINEERING to record the locations and invert elevations of all underground installations associated with Division 23 work.
- C. Miscellaneous Record Submittals: Provide the following in accordance with Division 1, specification section - CONTRACT CLOSEOUT:
1. Provide two copies of final approved Test and Balance Report, Piping Pressure Test and Duct Pressure Test Reports within a separate section identified for test reports within each set of Operation and Maintenance Manuals.
 2. Provide two copies of control manufacturer's certification that controls have been checked for operation and calibration and that system is operating as intended, within the controls section of the Maintenance Manuals.
 3. Provide two copies of acknowledgment of all required instructions by Owner with a separate section of the Operation and Maintenance Manuals identified for Owner instructions.
 4. Provide two copies of Owner acknowledgements for accepting spare parts and equipment.
 5. Provide two copies of all extended warranties within its related equipment section of the Operation and Maintenance Manuals.

1.7 OPERATION AND MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1, specification section - CONTRACT CLOSEOUT. In addition to the requirements specified in Division 1, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data (specified capacities, i.e., submittal

data) and tests and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. Provide parts list for all equipment, fixtures, valves and accessories.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.
5. Extended warranties for equipment.
6. Provide a separate tabbed section (one each) for Test Reports, HVAC Controls, Owner acknowledgements of received training, extra stock materials and test equipment and Warranties.

B. Maintenance manuals shall be on site for use during the final inspection.

1.8 SIZING

- A. Capacity: Provide equipment and material of sizes, capacities, power input, power ratings and dimensions indicated on the drawings, in the schedules and as specified.
- B. Fit and Clearance: All equipment, such as rooftop unit, air-handling equipment and filters, shall fit the space shown on the project drawings. Provide access for servicing, repairing and inspecting apparatus at least equal to that shown. Each item of equipment shall be installed without damage to the building, building equipment or the item itself. Verify building access constraints before delivery of equipment to the project site.
- C. Deviations: Equipment and material of greater or larger power, dimensions, capacity and ratings may be furnished, provided such proposed equipment is approved in writing and feeders, circuit breakers, conduit, motors, bases and equipment spaces are increased by the Contractor at no cost to the Government. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and shall be subjected to the requirements of commissioning tests specified in article "Quality Assurance," of this section.

1.9 COORDINATION

- A. General: Coordinate mechanical work with that of the other trades in order to:
 1. Avoid interference between general construction, mechanical, electrical, structural and other specialty trades.
 2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of mechanical equipment.

3. Indicate aisle ways and access ways required on coordinated shop drawings for mechanical equipment rooms.

1.10 POSTED OPERATING INSTRUCTIONS

- A. General: 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 legible (1/16" minimum height text) operating instructions and frame under glass or in approved laminated plastic non-fading prints with wall mount. 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 framed under glass and secured to prevent easy removal.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Protect materials, apparatus and equipment from damage, moisture, dirt, debris and work of other trades.
- C. Use of paper, cardboard or other flimsy material for protection will not be permitted. Replace damaged protective materials immediately. Do not install damaged materials, apparatus and equipment; remove from site.
- D. After equipment (i.e., rooftop units, AHUs etc.) and gauges (pressure and temperature) have been installed, cover with a protective material and keep covered until all painting and insulating work has been completed. The subject equipment shall not be operated while it has a protective covering. At final inspection, all equipment shall be free of stains, scratches and foreign debris. All equipment finishes that do not meet these requirements shall be sanded, primed and painted to match original paint finish.

1.12 WARRANTY AND SERVICE

- A. Refer to GENERAL CONDITIONS and Division 1, specification section - WARRANTIES.
- B. Where extended warranties are called for herein, furnish three copies to be inserted in Operation and Maintenance Manuals.
- C. All preventative maintenance and normal service will be performed by the Owner's maintenance personnel after final acceptance of the work. This shall not alter the Contractor's warranty of the work in any way.
- D. Warranty period of mechanical Equipment and systems shall start after final acceptance of subject equipment and systems by Architect/Engineer (A/E) or the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials and equipment shall be new. Systems shall be provided complete, and each system as a whole, and in all its parts, shall function correctly up to the specified capacity. Should a system, or any part thereof fail to meet performance requirements, necessary replacements, alterations or repairs, as required by the Architect- Engineer, shall be made to bring performance up to specified requirements and all building construction and finishes damaged or marred by such replacements, alterations or repairs shall be restored to prior condition, at no additional cost to the Owner.
- B. Where multiple items of equipment or materials are required they shall be the product of a single manufacturer.
- C. Before ordering any equipment, the size of all equipment shall be checked to easily fit spaces allotted on the drawings.
- D. Inserts, pipe sleeves, supports and anchorage of equipment shall be provided as specified herein. Where such items are to be set or embedded in concrete, masonry or similar work, the items shall be furnished and layout made at the proper time for the setting or embedment thereof so as to cause no delay in the work.
- E. The drawings are diagrammatic and may not detail all appurtenances required for the proper operation of all equipment. Provide such items for a complete and operable system.

2.2 MANUFACTURERS' NAMES AND CATALOG NUMBERS

- A. Specific references have been made to one or more manufacturers' names and model or catalog numbers. This does not indicate that the material and equipment specified is necessarily an "off the shelf" item; requirements for specific finishes, materials or other modifications may introduce variances from manufacturers' standards. Contractor shall ascertain that such modifications are fully considered.

2.3 DIAGRAMS, NAMEPLATES AND LABELS

- A. Nameplate: For each piece of power operated mechanical equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances and similar essential data. Nameplates shall be securely mounted in an accessible location. The nameplate of a distributing agent will not be accepted.
- B. In all areas having equipment, valves and control devices, provide single line diagrams framed under glass and mounted on equipment room wall. Diagrams shall be black lines on white vellum. The diagrams shall give name, number designation, and location of each piece of equipment, valve, and control device.
- C. All pieces of equipment, (i.e., valves, starters, ducts, piping, disconnects, terminal units, AHUs, control instrumentation, control panles, etc.) to include all electrical

control instruments and apparatus shall be identified as specified in Division 23, Section 230553 - MECHANICAL IDENTIFICATION.

PART 3 - EXECUTION

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Use manufacturer's installation, rough-in, and maintenance documentation to identify space requirements and location of equipment.

3.2 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical, fire protection and plumbing systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate mechanical, fire protection and plumbing systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical, fire protection and plumbing installations.
 - 4. 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.
 - 5. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of mechanical, fire protection and 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.
 - 8. Install systems, materials, and equipment to conform with approved submittal data to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect prior to installation.
 - 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components. Piping shall be sloped as specified in individual sections.

10. Install mechanical, fire protection and plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panel or doors where access is required behind finished surfaces. Access panels and doors are specified in Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope. Maintain minimum specified slope without sagging.

3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1, specification section - CUTTING AND PATCHING. In addition to the requirements specified in Division 1, the following requirements apply:
 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical, fire protection and plumbing equipment and materials required to:
 1. Uncover work to provide for installation of ill-timed work.
 2. Remove and replace defective work.
 3. Remove and replace work not conforming to requirements of the Contract Documents.
 4. Remove samples of installed work as specified for testing.
 5. Install equipment and materials in existing structures.
 6. Upon written instructions from the Architect, uncover and restore work to provide for Architect observation of concealed work.
- C. Protect the structure, furnishings, finishes, and adjacent materials not to be removed.
- D. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 1. Patch existing finished surfaces and building components using new materials matching existing materials by experienced installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
 2. Patch finished surfaces and building components using new materials specified for the original installation by experienced installers. Installers'

qualifications refer to the materials and methods required for the surface and building components being patched.

3.4 INSTRUCTION OF OWNER'S OPERATING PERSONNEL

- A. The Contractor shall include the cost of the services of qualified instructor(s) to instruct the Owner's operating personnel in the operation, adjustment, care and maintenance of all equipment and systems.
- B. Instruction shall be performed at a time approved by the Owner after all equipment and systems are installed, completed, adjusted and operating to specified requirements. Contractor shall notify the Architect when instructions will be given.
- C. Qualification of instructor(s) shall be subject to approval of the Owner and equipment manufacturer.
- D. Additional requirements concerning operation and maintenance of mechanical equipment and systems may be specified in other sections.
- E. Two copies of acknowledgement of all required instructions to Owner's operating personnel, signed by the Owner or his authorized representative, shall be submitted to the Architect prior to submitting application for final payment. An additional copy of this acknowledgement is required in each copy of Operation and Maintenance Manuals required in Division 1, specification section - CONTRACT CLOSEOUT.

END OF SECTION 230100

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**SECTION 230200 – BASIC MECHANICAL
MATERIALS AND METHODS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including GENERAL CONDITIONS, SUPPLEMENTARY CONDITIONS and Division 1 specification sections, apply to this section.

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 23 Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete equipment base construction requirements.
 - 3. Equipment nameplate data requirements.
 - 4. Labeling and identifying mechanical systems and equipment is specified in Division 23, Section 230553 - MECHANICAL IDENTIFICATION.
 - 5. Nonshrink grout for equipment installations.
 - 6. Field-fabricated metal and wood equipment supports.
 - 7. Installation requirements common to equipment specification Sections.
 - 8. Cutting and patching.
 - 9. Touchup painting and finishing.

1.3 DEFINITIONS

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, mechanical equipment rooms, electrical rooms and air handling unit equipment rooms.

- D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include ductwork and piping located above ceilings and in shafts.
- F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract, including GENERAL CONDITIONS, SUPPLEMENTARY CONDITIONS and Division 1 Specification sections, apply to sections of Division 23.
- B. Product data for following piping specialties:
 - 1. Mechanical sleeve seals.
 - 2. Identification materials and devices.
- C. Samples of color, lettering style, and other graphic representation required for each identification material and device.
- D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- E. Coordination drawings for access panel and door locations.
- F. Prepare coordination drawings according to Division 1, specification section - SUBMITTALS. Drawings shall be 1/4 inch equals 1 foot (1:48) scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:
 - 1. Proposed locations of piping, ductwork, equipment, and materials. Include the following:
 - a. Planned piping layout, including valves and equipment locations.
 - b. Planned duct systems layout, including elbow radii and duct accessories (fire dampers, balancing dampers and access doors).
 - c. Clearances for installing and maintaining insulation.

- d. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - e. Equipment service connections and support details.
 - f. Exterior wall and foundation penetrations.
 - g. Fire-rated wall and floor penetrations.
 - h. Sizes and location of required concrete pads and equipment bases.
- 2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
- 3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
- 4. Reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.
- G. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."
- B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is identified by the contractor in advance and the referenced equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased to properly suit the larger equipment at no additional cost. No additional costs will be approved for these increases, if the contractor proposed larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements. The equipment must also meet all of the design performance requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical support services to mechanical equipment to include electrical device and material sizing, duty, type, location, fusing, conductor quantity and disconnect means to suit the supplied mechanical equipment items furnished as work of Division 23.
- F. 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.
- G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8. The contractor shall acknowledge via submission of bid that all such required access doors and panels shall be provide for each equipment item requiring access. The access doors and panels shall each be of a custom color finished to match the adjacent surface finish color in which they are mounted. The custom colors shall be selected by the Architect/Engineer at the time of the access door and panel submittal. The submittal of the access doors and panels shall reference their respective coordination drawings with unique individual access door and panel identifiers to allow for the individual color identification for each access door and panel.

- H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual piping system specification Sections in Division 15 for special joining materials not listed below.
- B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
 - 2. ASME B16.20 for grooved, ring-joint, steel flanges.
 - 3. AWWA C110, rubber, flat face, 1/8 inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.
- D. Solder Filler Metal: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.
- E. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.

- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 PIPING SPECIALTIES

- A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.
 - 1. Inside Diameter: Closely fit around pipe, tube, and insulation.
 - 2. Outside Diameter: Completely cover opening.
 - 3. Cast Brass: One-piece, with set-screw.
 - a. Finish: Polished chrome plate.
 - 4. Cast Brass: Split casting, with concealed hinge and set-screw.
 - a. Finish: Polished chrome plate.
- B. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.
 - 1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
 - 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
 - 3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig (1725kPa) minimum working pressure at a 180 deg F (82 deg C) temperature.
 - 4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150 psig (1035kPa) minimum pressure to suit system pressures.
 - 5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 150 psig (1035kPa) minimum working pressure to suit system pressures.
 - 6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig (2070kPa) minimum working pressure at 225 deg F (107 deg C) temperature.
 - 7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end

types and 300-psig (2070kPa) working pressure at 225 deg F (107 deg C) temperature.

- C. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.
- D. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 2. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, mechanical sleeve seal and galvanized pipe sleeve.
 - a. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seal.

2.4 IDENTIFYING DEVICES AND LABELS

- A. Refer to Division 23, Section 230553 - MECHANICAL IDENTIFICATION for identifying devices and labels. All mechanical equipment, vessels, tanks, piping, ductwork and control devices shall be identified. The use of equipment manufacturer applied labels shall not constitute compliance with this requirement. Pay specific attention to the level of detail information required for each label based on labeled device type.

2.5 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS--COMMON REQUIREMENTS

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 23 specify piping installation requirements unique to the piping system.
- B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations

and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are indicated and approved on coordination drawings.

- C. Install piping at indicated slope.
- D. Install components having pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around finished insulation to include jacketing.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's printed instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.
 - 2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set - screw.
 - 3. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.
- N. Sleeves are not required for core drilled holes.
- O. Permanent sleeves are not required for holes formed by PE plastic (removable) sleeves.
- P. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.

1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend sleeve fittings below floor slab as required to secure clamping ring where specified.
 - b. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum board partitions.
 2. Build sleeves into new walls and slabs as work progresses.
 3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 1/2 inch and larger.
 - 1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.
 - b. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum board partitions.
 4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants specified in Section - JOINT SEALANTS.
- Q. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
1. Install galvanized Schedule 40 steel pipe with water stop for sleeves 1/2 inch and larger.
 2. Assemble and install mechanical seals according to manufacturer's printed instructions.
- R. Below Grade, Exterior Wall, Pipe Penetrations: Install galvanized Schedule 40 steel pipe with water stops for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
- S. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping sealant material. Firestopping materials are specified in Section THROUGH-PENETRATION FIRESTOP SYSTEM.
- T. Verify final equipment locations for roughing in.
- U. Refer to equipment specifications in other Sections for roughing-in requirements.

- V. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
 4. Brazed Joints: Construct joints according to AWS "Brazing Manual" in the "Pipe and Tube" chapter.
 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
 - a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 - f. Bullhead tee fittings are not acceptable.
 6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article. Bullhead tee fittings are not acceptable.
 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench. Bullhead tee fittings are not acceptable.

- W. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection. Provide dielectric unions whenever the piping has piping material transition.
 2. Install flanges in piping 2-1/2 inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
 3. Wet Piping Systems (Water): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.
- F. Bullhead tee fittings are not acceptable.

3.3 PAINTING AND FINISHING

- A. Refer to Section - PAINTING for field painting requirements.
- B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Repair all prime painted surfaces including weld pipe joints.
- D. All piping systems to include pipe, pipe hangers, pipe supports, valves, and other pipe appurtenances located in exposed areas, unconcealed areas, or above ceiling areas with visibility through the ceiling material as is the case in the landside ticket lobby and baggage claim lobbies, shall be painted a custom color as selected by the Architect/Engineer in accordance with Section – PAINTING.

- E. All ductwork systems to include supply, return, relief, exhaust, outside air and transfer ductwork located above ceiling areas with visibility through the ceiling material as is the case in the landside ticket lobby and baggage claim lobbies, shall be painted a custom color as selected by the Architect/Engineer in accordance with Section – PAINTING.
- F. All air distribution devices located in sidewall locations shall be provided with factory custom color finish as selected by the Architect/Engineer. The color selection shall occur during the shop drawing submittal review process. The contractor shall expect the use of a single custom finish color for each individual device, with numerous colors being used and required for different device locations for the painting of the referenced devices based on the finish colors specified for each specific device location. In explanation, the diffusers in the

3.4 CONCRETE BASES

- A. Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive strength concrete and reinforcement as specified in Section - CAST-IN-PLACE CONCRETE.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.7 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.8 GROUTING

- A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms for placement of grout, as required.
- D. Avoid air entrapment when placing grout.
- E. Place grout to completely fill equipment bases.
- F. Place grout on concrete bases to provide a smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 230200

**NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION – 230513
MOTORS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. This section includes basic requirements for motors. It includes motors that are factory-installed as part of equipment and appliances as well as field-installed motors.
- B. Requirements of the following Division 23 Sections apply to this section:
 - 1. Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS
 - 2. Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70, "National Electrical Code."
- B. NRTL Listing: Provide NRTL listed motors.
 - 1. Term "Listed": As defined in "National Electrical Code," Article 100.
 - 2. Listing Agency Qualifications: "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Comply with NEMA MG 1, "Motors and Generators."
- D. Comply with UL 1004, "Motors, Electric"

PART 2 - PRODUCTS

2.1 MOTORS, GENERAL

- A. General: Requirements below apply to motors covered by this section except as otherwise indicated.
- B. Motors 1/2 HP and Larger: Premium energy-efficient polyphase.
- C. Motors Smaller Than 1/2 HP: Single-phase.
- D. Frequency Rating: 60 Hz.
- E. Voltage Rating: Determined by voltage of circuit to which motor is connected for the following motor voltage ratings (utilization voltages):

1. 120 V Circuit: 115 V - motor rating.
 2. 208 V Circuit: 200 V - motor rating.
 3. 240 V Circuit: 230 V - motor rating.
 4. 480 V Circuit: 460 V - motor rating.
- F. Service factors indicated for motors are minimum values and apply at frequency and utilization voltage at which motor is connected. Provide motors which will not operate in service factor range when supply voltage is within 10 percent of motor voltage rating.
- G. Capacity: Sufficient to start and operate connected loads at designated speeds in indicated environment, and with indicated operating sequence, without exceeding nameplate ratings. Provide motors rated for continuous duty at 100 percent of rated capacity.
- H. Temperature Rise: Based on 40 degrees C ambient except as otherwise indicated.
- I. Enclosure: Open dripproof or as indicated.
- J. Service Factor: Minimum 1.15.

2.2 POLYPHASE MOTORS

- A. General: Squirrel-cage induction-type conforming to the following requirements except as otherwise indicated.
- B. NEMA Design Letter Designation: "B."
- C. Multi-Speed Motors: Separate winding for each speed.
- D. Energy Efficient Motors: Nominal efficiency equal to or greater than that stated in NEMA MG 1, table 12-6B for that type and rating of motor.
- E. Energy Efficient Motors: Nominal efficiency equal to or greater than that stated in NEMA MG 1, table 12-6C for that type and rating of motor.
- F. Variable Speed Motors for Use With Solid-State Drives: Energy efficient, squirrel-cage induction, design B units with ratings, characteristics, and features coordinated with and approved by drive manufacturer.
- G. Internal Thermal Overload Protection For Motors: For motors so indicated, protection automatically opens control circuit arranged for external connection. Protection operates when winding temperature exceeds safe value calibrated to the temperature rating of the motor insulation.
- H. Bearings: Double-shielded prelubricated ball bearings suitable for radial and thrust loading of the application.
- I. Rugged Duty Motors: Totally enclosed with 1.25 minimum service factor. Provide motors with regreasable bearings and equipped with capped relief vents. Insulate windings with nonhygroscopic material. External finish shall be chemical resistant paint over corrosion resistant primer. Provide integral condensate drains.

- J. Motors for Reduced Inrush Starting: Coordinate with indicated reduced inrush controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.

2.3 SINGLE-PHASE MOTORS

- A. General: Conform to the following requirements except as otherwise indicated.
- B. Provide Energy Efficient Motors: One of the following types as selected to suit the starting torque and other requirements of the specific motor application.
 - 1. Permanent Split Capacitor.
 - 2. Split-Phase Start, Capacitor-Run.
 - 3. Capacitor-Start, Capacitor-Run.
- C. Shaded-Pole Motors: Use only for motors smaller than 1/20 hp.
- D. Internal Thermal Overload Protection for Motors: For motors so indicated, protection automatically opens the power supply circuit to the motor, or a control circuit arranged for external connection. Protection operates when winding temperature exceeds a safe value calibrated to the temperature rating of the motor insulation. Provide device that automatically resets when motor temperature returns to normal range except as otherwise indicated.
- E. Bearings, belt connected motors and other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single-phase motors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: The following requirements apply to field-installed motors.
- B. Install motors in accordance with manufacturer's published instructions and the following:
 - 1. Direct Connected Motors: Mount securely in accurate alignment.
 - 2. Belt Drive Motors: Use adjustable motor mounting bases. Align pulleys and install belts. Use belts identified by the manufacturer and tension belts in accordance with manufacturer recommendations.

3.2 COMMISSIONING

- A. Check operating motors, both factory and field-installed, for unusual conditions during normal operation. Coordinate with the commissioning of the equipment for which the motor is a part.
- B. Report unusual conditions.
- C. Correct deficiencies of field-installed units.

END OF SECTION 230513

**NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 230529
HANGERS AND SUPPORTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. This section includes hangers and supports for mechanical systems piping and equipment.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS
 - 2. Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS
 - 3. Division 23, Section 230548 - VIBRATION CONTROL

1.3 DEFINITIONS

- A. Terminology used in this section is defined in MSS SP-90.

1.4 PERFORMANCE REQUIREMENTS

- A. Design seismic restraint Hangers and supports, for piping and equipment.
- B. Design and obtain approval from authority with jurisdiction over seismic restraint Hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of Hanger and support.
- C. Submit pipe Hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe Hanger and support.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- E. Shop drawings for each type of Hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

- F. Licensed Engineer's Hanger and support drawings specified in the "Quality Assurance" Article.
- G. Licensed Engineer's Hanger and support installation report specified in the "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code - Steel."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- C. NFPA Compliance: Comply with NFPA 13 for Hangers and supports used as components of fire protection systems.
- D. Listing and Labeling: Provide Hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
 - 1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.
- F. Licensed Engineer: Prepare Hanger and support design drawings, and calculations for seismic restraint of piping and equipment. Include seal and signature of Registered Engineer, licensed in jurisdiction where project is located, certifying compliance with specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
 - 1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
 - 2. Provide pipe Hangers, clamps and components with copper coating for electrolytic protection where attachments are in direct contact with copper tubing and plastic coating for use with plastic pipes.
- B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate or foam glass with sheet metal shield. Insert cover entire circumference of pipe and are of length indicated for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building

materials where used. Fasteners for fire protection systems include UL listing and FM approval.

- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A36/A36M, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F844, steel, plain, flat washers.
- D. Grout: ASTM C1107, Grade B, nonshrink, nonmetallic.
 - 1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Water: Potable.
 - 4. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific Hanger requirements are specified in the section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe Hanger selections and applications that are not specified in piping specification sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. General: Comply with MSS SP-69 and SP-89. Install Hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze Hangers where possible. Clamp all piping to support; maintain spacing and alignment.
- C. Install supports with maximum spacings as specified in individual piping sections.
 - 1. Provide addition Hangers or supports within two feet of elbows, tees or change of direction.
- D. Where pipes of various sizes are supported together by trapeze Hangers, space Hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe Hangers.

- E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated. Do not support piping from metal deck; Provide miscellaneous steel to span between beam or joist. Install additional attachments at 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 to forms. Install reinforcing bars through openings at top of inserts. Attach to steel beams with beam clamps and clips; to joist by through bolting web with two-inch-square heavy washers.
- F. Install concrete inserts in new construction prior to placing concrete.
- G. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- I. Install Hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- K. Support fire protection systems piping independent of other piping.
- L. Install Hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Load Distribution: Install Hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install Hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- O. Insulated Piping: Comply with the following installation requirements.
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps surrounding insulation; do not exceed pipe stresses allowed by ASME B31.9.
 - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - 3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields span an arc of 180 degrees (3.1 rad) and have dimensions in inches (mm) not less than the following:

| <u>NPS (Inches)</u> | <u>LENGTH (Inches)</u> | <u>THICKNESS (Inches)</u> |
|---------------------|------------------------|---------------------------|
| 1/4 to 3-1/2 | 12 | 0.048 |
| 4 | 12 | 0.060 |
| 5 and 6 | 18 | 0.060 |
| 8 to 14 | 24 | 0.075 |
| 16 to 24 | 24 | 0.105 |

4. Pipes 2 Inches and Larger: Include thermal inserts.
5. Insert Material: Length 1 inch longer than protective shield.
6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust Hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint and paint exposed areas immediately after erection of 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 by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

- B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9, PAINTING.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

3.7 FIELD QUALITY CONTROL

- A. Licensed Engineer's Report: Prepare Hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where project is located, certifying compliance with specifications.

END OF SECTION 230529

**NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 230548 –
VIBRATION CONTROL**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division 23 sections.
- B. Types of vibration control products specified in this section include the following:
 - 1. Fiberglass pads and shapes.
 - 2. Neoprene pads.
 - 3. Vibration isolation springs.
 - 4. Pad-type isolators.
 - 5. Plate-type isolators.
 - 6. Double-plate-type isolators.
 - 7. Threaded double-plate-type isolators.
 - 8. All directional anchors.
 - 9. Neoprene mountings.
 - 10. Spring isolators, freestanding.
 - 11. Spring isolators, housed.
 - 12. Spring isolators, vertically restrained.
 - 13. Spring isolators, earthquake restrained.
 - 14. Seismic snubbers.
 - 15. Thrust restraints.
 - 16. Equipment rails.
 - 17. Fabricated equipment bases.
 - 18. Inertia base frames.
 - 19. Roof-curb isolators.
 - 20. Isolation hangers.
 - 21. Riser isolators.
 - 22. Flexible pipe connectors.
- C. Related Sections:
 - 1. Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS
 - 2. All Division 23 specifications relating to vibration isolated equipment and materials
 - 3. Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS

1.3 QUALITY ASSURANCE

- A. Except as otherwise indicated, obtain vibration control products from single manufacturer.

- B. Engage manufacturer to provide technical supervision of installation of vibration control products.

1.4 SUBMITTALS

- A. Vibration Isolation Mounts and Hangers: Provide catalog cuts, 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. Submittals based upon rated deflection will be rejected. Indicate the weight and lowest rotational or reciprocal speed of each piece of isolated equipment. Indicate bridge bearing quality neoprene components where provided. Use the format below to summarize isolator characteristics for submittal review by the Engineer.
- B. Elastomeric Pads: For pads supporting equipment (not piping), submit calculations showing supported weight, required deflection, pad support area, load per square inch, operating deflection, unloaded pad height (not including shims and top plate) and percent deflection. Indicate bridge bearing quality neoprene where provided.
- C. Equipment Bases: Provide detail 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. Seismic Certification: A licensed professional engineer experienced in the design of restraints for flexibly mounted equipment, 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 regarding seismic restraint of all resiliently mounted equipment. Provide calculations and analysis showing compliance with the applicable codes.
- F. Shop Drawings: Submit shop drawings and manufacturer's installation instructions for thrust restraints and sway braces wherever they are required. Submit shop drawings for piping isolation details where Type A pads are used; see paragraph "Piping Isolation."
- G. Reports: Provide inspection reports from the isolation materials manufacturer or representative indicating that the installations are complete and correct in every respect.
- H. Samples: Submission of samples may be requested for each type of isolation device. After approval, samples will be returned for installation at the job. All costs associated with submission of samples shall be borne by the Contractor.
- I. Written Certificate Required: Contractor & Manufacturer shall certify that products, materials and processes submitted do not contain asbestos or PCB.

1.5 DRAWINGS ARE SCHEMATIC ONLY

- A. The size and number of mounts and hangers shall be chosen to meet these specifications. Brackets, rails, bases, braces, snubbers, etc. shall be provided as needed for a complete and correct installation.

1.6 STANDARDS

- A. American Association of Safety and Highway Officials (AASHO), Highway Bridge Specification. See table B requirements for physical properties of bridge bearing quality neoprene.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering vibration control products which may be incorporated in the work include, but are not limited to, the following:
- B. Manufacturer: Subject to compliance with requirements, provide vibration control products of one of the following:
 1. Amber/Booth Co.
 2. Korfund Dynamics Corp.
 3. Mason Industries, Inc.
 4. Peabody Noise Control, Inc.
 5. Kinetics Noise Control, Inc.
- C. Since manufacturer's products vary, specific models listed in this specification may not be approved if they do not meet all requirements in this section. Model designations listed herein are intended only as a guide.

2.2 VIBRATION CONTROL MATERIALS

- A. Spring Requirements:
 1. Steel springs and neoprene elements shall have static deflections under operating load equal to or greater than deflections shown on the documents.
 2. All steel springs as installed shall have a minimum additional travel to solid (coil bind) equal to 50 percent of the deflection under operating load.
 3. Spring diameter shall be no less than 80 percent of the compressed height of the spring at operational load.
 4. Steel springs shall not be welded to other elements of the isolator unless specifically noted in the submittal and approved by the Engineer.
 5. Steel springs shall not take a permanent set when compressed to coil bind.
 6. Steel springs shall be color coded to allow positive identification after installation.
- B. Elastomer Requirements:
 1. All elastomeric (neoprene) components shall be selected for maximum hardness of 40 durometer, shore A rating, where possible. In no case shall hardness exceed 50 durometer.

2. Bridge bearing quality neoprene meeting AASHTO Highway Bridge Specifications shall be used in all elastomeric components where installed in irretrievable locations and as noted elsewhere in the documents.
- C. Corrosion Resistance:
1. All isolators and associated hardware shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated, or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc electroplated. Structural steel bases and exposed steel components of concrete inertia bases shall be cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.
 2. All isolators exposed to the weather shall have steel parts PVC coated, hot-dip galvanized or zinc-electroplated plus coating of neoprene or bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel. Nuts, bolts, and washers may be zinc-electroplated.

2.3 VIBRATION ISOLATION EQUIPMENT

- A. Type A - Elastomeric Pads:
1. 5/16-inch minimum thickness waffled or ribbed neoprene pads Mason model W or SW, Amber-Booth model NR or Kinetics model NP. Where multiple layers are specified or are required to provide the specified deflection, pads shall be interleaved with 16-gauge steel shim plates, Mason model WSW or Amber-Booth model SP-NR style E. Size pads for deflection equal to 10 to 20 percent of unloaded height, except bridge bearing quality pads which shall be loaded 10 to 15 percent. Provide load distributing top plates if needed for uniform loading. Provide pads of sufficient thickness to achieve the specified minimum deflection.
- B. Type B - Neoprene-in-Shear Floor-Mount Isolators:
1. Steel bottom plates with bolt holes for bolting to foundations, threaded steel insert at top of the mounting for attaching equipment, and friction surfaces both top and bottom. All metal surfaces shall be neoprene covered to resist corrosion. Mounts shall be double deflection and designed for 0.25 to 0.35 inches deflection at rated load. Isolators shall be Mason model ND, Amber-Booth model RVD or Kinetics model RD.
- C. Type D - Open-Spring, Floor-Mount Isolators:
1. Freestanding and laterally stable with no housing, and shall have leveling adjustment bolts which shall be rigidly connected to the equipment. Provide with 1/4-inch minimum elastomeric friction pad Type A between the baseplate and the support. Vibration isolator vendor shall size elastomeric pads and associated load distributing shim plates to achieve deflection equal to 10 to 20 percent of the vertical thickness of the pads.
 2. If the mounting baseplate is to be bolted to the structure or framework rigidly connected to the structure, neoprene bushings and neoprene washers shall be used between each bolt and the isolator baseplate to prevent mechanical short circuit. These additional neoprene washers and bushings may be omitted only if the baseplate and friction pad incorporate neoprene elements that eliminate rigid contact between bolts and the baseplate. Bolt holes shall be properly sized to allow for bushings. The hold down bolt shall incorporate steel washers to distribute load evenly over neoprene washers. Isolators shall be Mason model SLF, Amber-Booth model SW or Kinetics model FDS.

- D. Type E - Restrained Open-Spring, Floor-Mount Isolators:
 - 1. For equipment with operating weight greater than installed weight, provide built-in adjustable limit stops to prevent equipment from rising when weight is removed. Isolators shall be as Type D above plus height limiting studs and adjustable nuts, with 1/2-inch minimum clearance around the studs. Elastomeric friction pads used in conjunction with Type E mounts for chillers and cooling towers shall be of bridge-bearing quality neoprene. Isolators shall be Mason model SLR, Amber-Booth model CT or Kinetics model FLS.
- E. Type F - Elastomeric Hanger:
 - 1. Neoprene-in-shear element mounted in a hanger box. The neoprene element shall be molded with a rod isolation bushing that prevents the rod from contacting the hanger box. Design for 0.25- to 0.35-inch minimum static deflection at rated load. Isolators shall be Mason model HD, WHD, Amber-Booth model BRD or Kinetics model RH.
- F. Type G - Spring and Neoprene in Series Isolator Hangers:
 - 1. Contain a steel spring and 0.3-inch deflection elastomeric element in series. Neoprene elements shall be molded with a rod isolation bushing that passes through the hanger box that prevents the rod from contacting the hanger box. The diameters of the spring and the hole in the mounting box shall allow for 15-degree misalignment from vertical before mechanical short circuit occurs. Isolators shall be Mason model 30N, Amber-Booth model BSRA or Kinetics model SRH.
- G. Type H - Precompressed Spring and Neoprene in Series Hanger:
 - 1. Equal to Type G including 15-degree misalignment capability. Isolator shall be precompressed to the rated deflection to allow installation at a fixed elevation. Hangers shall have a release mechanism to free the spring after installation and the hanger is subjected to its full load. Deflection shall be indicated by means of a scale. Isolators shall be Mason model PC30N or Amber-Booth model PBSRA.
- H. Type J - Thrust Restraints:
 - 1. Sets of two or more, and shall be springs in series with neoprene. 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. Thrust restraints shall be Mason model WB.
- I. Type K - Sway Braces:
 - 1. Sets of two or more and shall consist of aircraft cable, neoprene elements or neoprene and spring assemblies. Braces shall keep the equipment stable without restricting the free motion of the vibration isolators. Submit shop drawings for approval prior to installation.

2.4 BASES AND RAILS

- A. Type L - Inertia Bases:
 - 1. Concrete inertia bases shall be formed of stone-aggregate concrete (150 lbs./cu. ft.) and appropriate steel reinforcing cast between perimeter structural steel channels.

2. Inertia bases shall be built to form a rigid base which will not twist, deform, deflect, or crack in any manner which would negatively effect the operation of the supported equipment or the vibration isolation mounts.
3. Inertia bases shall be adequately sized to support basic equipment units and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure.
4. The steel frame and reinforcement shall be supplied by the vibration isolator manufacturer. Concrete may be provided by the Contractor.
5. Inertia base shall weigh a minimum of two times the weight of the supported equipment, and shall be a minimum of 6 inches thick. Spacing between isolators supporting the inertia base shall be a maximum of ten times the thickness of the inertia base. Bases shall have a minimum operating clearance of 2 inches above floor or housekeeping pad. Use height saving brackets as required to maintain proper clearances.

B. Type M - Steel Bases:

1. 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 which will negatively affect the operation of the supported equipment or the vibration isolation mounts.
2. Bases shall be adequately sized to support basic equipment and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure.
3. Steel bases shall be at least 6 inches thick. Spacing between isolators supporting the steel base shall be a maximum of ten times the thickness of the base. Bases shall have a minimum operating clearance of 2 inches above floor or housekeeping pad. Bases shall include side mounting brackets for attachment to vibration isolators.

C. Type N - Steel Rails:

1. 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. Rails shall include end mounting brackets for attachments of vibration isolators. Rails shall have a minimum operating clearance of 2 inches above the floor or housekeeping pad.

D. Type O - Roof-Curb Isolators:

1. Fabricated frame units sized to match roof curbs as shown, formed with isolation springs between extruded aluminum upper and lower sections, which are shaped and positioned to prevent metal-to-metal contact. Provide continuous airtight and waterproof seal between upper and lower extrusions. Include provisions for anchorage of frame unit to roof curb and for anchorage of equipment to unit.

2.5 WALL-MOUNT ISOLATORS

A. Type P - Captive Neoprene Wall Mount Isolators.

1. Mason model RBA, RCA or Peabody model RQ.

2.6 PIPE CONNECTORS

- A. Flexible Neoprene Piping Connectors:
 - 1. Straight-through twin spherical type, or single sphere elbow type, manufactured of nylon cord and neoprene with no steel wire or rings used as pressure reinforcement.
 - 2. Connectors shall be able to accept elongation, compression and axial and transverse movement.
 - 3. Connectors shall be selected to suit the system temperature, pressure and fluid type.
 - 4. No rods or cables shall be used to control extension of the connector.
 - 5. Mason "Twin-Flex" (not "Super-Flex") model MFTNC, MFTFU, MFNEC. Straight wall connectors are not acceptable except for sump pumps.
- B. Braided Hose Piping Connector:
 - 1. For nonferrous piping, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.
 - 2. For ferrous piping, provide stainless steel hose covered with stainless steel wire braid with NPT steel nipples or 150 psi ANSI flanges, welded to hose.
 - 3. Select connectors to suit system fluid type, pressure and temperature.
- C. Connections: Provide threaded male nipples for piping 2 inches and smaller; flanged connections for piping 2-1/2 inches and larger.
- D. All flexible connectors shall be installed strictly per manufacturers' instructions, without misalignment, torsional rotation or compression.

2.7 FLEXIBLE CONDUIT

- A. UL-listed liquidtight flexible conduit. Manufactured flexible conduit connector for sizes greater than 2 inches diameter shall be Crouse-Hinds type XD expansion / deflection coupling, or approved equal.

2.8 SEISMIC RESTRAINTS

- A. Shall be as recommend by the vibration isolation manufacturer, and shall be shown on the shop drawings, which is the basis of the required seismic certification.

2.9 ELASTOMERIC GROMMETS

- A. Combination of neoprene washer and bushing, Mason models HLIW and HLIB or E.A.R. (Indianapolis, Indiana) Isodamp, C-1000, ring bushing and washer combination.
- B. Elastomer shall be 56 durometer maximum. Grommets shall be formed to prevent bolts from directly contacting the secured item.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 GENERAL

- A. All HVAC, plumbing and fire protection equipment, ductwork, piping and other equipment shall be resiliently mounted on or suspended from approved foundations and supports, with isolation pads, mounts and hangers as specified herein and as shown on drawings. Seismic restraints shall be installed in strict conformance with the certified shop drawings. Location of all isolation equipment shall be selected for ease of inspection and adjustment as well as for proper operation.
- B. Mounts and Hangers:
 - 1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.
 - 2. Isolators for equipment with bases shall be located on the sides of the base which are parallel to the equipment shaft.
 - 3. If a housekeeping pad is provided, isolator base plates shall rest entirely on the pad.
 - 4. Hangers for vibration isolators shall be connected to structural beams or joists, not from the floor slab between beams and joists. Provide intermediate support members as necessary.
 - 5. Vibration isolation hangers shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure. Provide 1/2-inch minimum 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.
 - 6. Parallel pipes may be hung together on a trapeze which is isolated from the structure. Isolator deflections must equal the greatest deflection for those pipes if isolated individually.
 - a. Do not mix isolated and non-isolated pipes on the same trapeze.
 - 7. Limit stops shall be out of contact during normal operation.
 - 8. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.
 - 9. Contractor may elect to use Type E instead of Type D, Type H instead of Type G, to simplify installation.
- C. All concrete inertia bases and required steel reinforcing shall be furnished and installed under this section. Dense aggregate concrete shall be poured within structural frames under the supervision of the contractor responsible for the work of this section.
- D. Floor Clearances:
 - 1. All floor-mounted equipment shall have a minimum operating clearance of 1 inch between the bottom of the equipment or inertia base and the floor or housekeeping pad. Check to ensure that this space is completely clear after installation is complete.
 - 2. Provide height saving brackets as needed. Where housekeeping pads are provided, coordinate isolator locations with size of housekeeping pads especially where outboard mounts are used with height saving brackets.
- E. Deflections:
 - 1. Vibration isolation systems shall be designed to have deflections equal or greater than indicated on drawings and specifications; or as recommended by ASHRAE for the application. Where multiple deflection requirements apply to a single isolator, the greater deflection shall prevail.

2. Isolators supporting equipment with center of gravity that is asymmetrical in plan shall be selected for nearly equal deflection under actual load.
 3. Number and size of mountings shall be determined by vibration isolation manufacturer. Install isolators in accordance with manufacturer's instructions.
- F. Thrust Restraints:
1. Maximum motion shall be 1/4 inch under start-up or shut-down conditions for each floor or ceiling supported piece of equipment. Motions in excess shall be restrained by approved thrust restraints Type J attached at the centerline of the thrust, and arranged symmetrically on the unit.
 2. Restraints anchor to fixed supports of stiffness greater than the thrust to be countered, and not to resiliently supported ductwork. Adjust according to manufacturer's instructions.
 3. Shop drawings and manufacturer's installation instructions for thrust restraints shall be submitted for approval prior to installation.
- G. Isolated Systems Shall be Independent:
1. Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes or ductwork installed on vibration isolators. Maintain 2 inches clearance between isolated equipment and walls, ceilings and other equipment.
 2. Drain piping connected to vibration isolated equipment shall not contact the building structure or other non-isolated systems unless it is resiliently mounted.
- H. Stabilize All Isolated Equipment:
1. Provide resilient sway bracing to solid anchor points to stabilize all equipment with center of gravity sufficiently above the plane of isolation mounts (such as vertical air handlers) to cause the top of the equipment to move more than 1/2 inch.
- I. Treat All Isolation Systems for Corrosion Resistance:
1. Coatings damaged during installation shall be repaired.

3.3 CEILING SUPPORTED FANS AND FAN COILS

- A. Hang with spring and neoprene in series hangers Type G.
- B. If equipment to be mounted is not furnished with integral structural frames and external mounting lugs of suitable strength and rigidity, provide structural sub-base to support equipment and to which hangers shall be attached.
- C. Thrust restraints Type J shall be provided as required to limit motion to 1/4 inch maximum under fan operating, start-up and shut-down conditions.
- D. Minimum deflection one inch.

3.4 CURB-MOUNTED ROOFTOP FANS

- A. Supply with factory-installed neoprene vibration isolators separating the motor, drive assembly and impeller from the base. There shall be no rigid short circuit of these

isolators through bolting, rigid conduit or other components of the curb-mounted assembly.

- B. Selected fans shall be disassembled at the site for verification of correct isolation by the Engineer.
- C. Rooftop fans found to be insufficiently isolated shall be installed with elastomeric pads Type A, correctly sized, entirely separating the fan base from the curb.

3.5 DUCTWORK ISOLATION

- A. Flexible duct connections as specified in Division 23, Section 233300 - DUCT ACCESSORIES shall be provided at all fan inlets and outlets between the fan and the first duct hanger or support.
- B. Provide resilient support for all ductwork in mechanical equipment rooms. Ducts shall be resiliently supported by elastomeric hangers Type F, with a static deflection of 0.25 to 0.35 inch, except as noted below.
- C. Supply ducts below RC 20 spaces with velocities over 1000 FPM shall be supported on spring and neoprene in series hangers Type G.
- D. All ductwork with air velocities in excess of 1,500 feet per minute shall be supported by elastomeric hangers Type F with a static deflection of 0.25 to 0.35 inch.

3.6 CENTRIFUGAL FANS:

- A. Fans and bases shall be supported on open-spring, floor-mount isolators Type D. Minimum deflection 1-1/2 inch.
- B. Thrust restraints Type J shall be provided as scheduled or required to limit motion to 1/4 inch maximum under fan operating, start-up and shut-down conditions.

3.7 TRANSFORMERS, MOTOR CONTROL CENTERS, MOTOR STARTERS, DIMMER CABINETS

- A. All electrical coil devices, including entire transformers (core and housing), shall be placed on neoprene-in-shear, floor-mount isolators Type B of bridge bearing quality neoprene, or captive neoprene, wall-mount isolators Type P. Connect with flexible conduit as described below.

3.8 FLEXIBLE CONDUIT

- A. Provide to isolate vibration from all rotating equipment, plus transformers, dimmers, motor starters and fluorescent fixture ballast cabinets. Install between equipment and first rigid conduit anchor.
 - 1. For conduit up to 2 inches diameter, provide a slack flexible conduit.
 - 2. For conduit larger than 2 inches diameter, provide a premanufactured flexible conduit connector.

3.9 ELEVATOR EQUIPMENT

- A. Mount elevator hydraulic units on double layer elastomeric pads Type A of bridge bearing quality, or neoprene-in-shear floor mount isolators Type B. Mounting bolts

used through pads shall be completely separated from the equipment using elastomeric grommets. All hydraulic lines shall be resiliently separated from structure using elastomeric pads Type A.

END OF SECTION 230548

**NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 230553
MECHANICAL IDENTIFICATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. Types of identification devices specified in this section include the following:
 - 1. Painted identification materials.
 - 2. Plastic pipe markers.
 - 3. Plastic tape.
 - 4. Plastic duct markers.
 - 5. Valve tags.
 - 6. Valve schedule frames.
 - 7. Engraved plastic-laminate signs.
 - 8. Plastic equipment markers.
 - 9. Plasticized tags.
- B. Requirements of the following Division 23 sections apply to this section:
 - 1. Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS
 - 2. Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Codes and Standards:
 - 1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.4 SUBMITTALS

- A. General: Submit the following:
- B. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2 x 11 inches bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags," in margin of

schedule. In addition to mounted copies, furnish extra copies for Operating and Maintenance Manuals.

- D. Maintenance Data: Include product data and schedules in Operating and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
1. Allen Systems, Inc.
 2. Brady (W.H.) Co.; Signmark Div.
 3. Industrial Safety Supply Co., Inc.
 4. Seton Name Plate Corp.

2.2 MECHANICAL IDENTIFICATION MATERIALS

- A. General: Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for application, selection is installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS

- A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-1/4-inch high letters for ductwork and not less than 3/4-inch high letters for access door signs and similar operational instructions.
- B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
- C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.4 PLASTIC PIPE MARKERS

- A. Snap-On Type: Provide manufacturer's standard preprinted, semirigid snap-on, color-coded pipe markers, complying with ANSI A13.1
- B. Pressure-Sensitive Type: Provide manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.
- C. Small Pipes: For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
1. Snap-on application of pretensioned semirigid plastic pipe marker.
 2. Adhesive lap joint in pipe marker overlap.
 3. Laminated or bonded application of pipe marker to pipe (or insulation).

4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inches.
- D. Large Pipes: For external diameters of 6 inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three times letter height (and of required length), fastened by one of the following methods:
1. Laminated or bonded application of pipe marker to pipe (or insulation).
 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide; full circle at both ends of pipe marker, tape lapped 3 inches.
 3. Strapped-to-pipe (or insulation) application of semirigid type, with manufacturer's standard stainless steel bands.
- E. Lettering: Manufacturer's standard preprinted nomenclature which best describes piping system in each instance, as selected by Architect in cases of variance with names as shown or specified.

2.5 PLASTIC DUCT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color code:
1. Green: Cold air.
 2. Yellow: Hot air.
 3. Yellow / Green: Supply air.
 4. Blue: Exhaust, outside, return, and mixed air.
 5. For hazardous exhausts, use colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following:
1. Direction of airflow.
 2. Duct service (supply, return, exhaust, etc.).
 3. Duct origin (from).
 4. Duct destination (to).
 5. Design cfm.

2.6 PLASTIC TAPE

- A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- B. Width: Provide 1-1/2-inch wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6 inches, 2-1/2-inch wide tape for larger pipes.
- C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.7 VALVE TAGS

- A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2-inch high, and with 5/32-inch hole for fastener.
1. Provide 1-1/2-inch diameter tags, except as otherwise indicated.
 2. Fill tag engraving with black enamel.

- B. Valve Tag Fasteners: Provide manufacturer's standard 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.
- C. Access Panel Markers: Provide manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8-inch center hole to allow attachment.

2.8 VALVE SCHEDULE FRAMES

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.9 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness: 1/16 inch for units up to 20 square inches or 8-inch length; 1/8 inch for larger units.
- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.10 PLASTIC EQUIPMENT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:
 1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
 3. Yellow / Green: Combination cooling and heating equipment and components.
 4. Brown: Energy reclamation equipment and components.
 5. Blue: Equipment and components that do not meet any of the above criteria.
 6. For hazardous equipment, use colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 1. Name and plan number.
 2. Equipment service.
 3. Design capacity.
 4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- C. Size: Provide approximate 2-1/2 x 4 inch markers for control devices, dampers, and valves; and 4-1/2 x 6 inches for equipment.

2.11 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation / maintenance of mechanical, fire protection and plumbing systems and equipment.
 - 1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: 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.

3.2 DUCTWORK IDENTIFICATION

- A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; or provide stenciled signs and arrows, showing specified information, in black or white (whichever provides most contrast with ductwork color).
- B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50-foot spacings along exposed runs.
- C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

3.3 EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
 - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - 2. Meters, gauges, thermometers and similar units.
 - 3. Fans, blowers, primary balancing dampers and mixing boxes.
 - 4. Packaged HVAC rooftop units or zone-type units.

- B. Optional Sign Types: Where lettering larger than 1-inch height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at installer's option.
- C. Lettering Size: Minimum 1/4-inch high lettering for name of unit where viewing distance is less than 2 feet, 0 inches, 1/2-inch high for distances up to 6 feet, 0 inches, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
- D. 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.

3.4 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 230553

**NEW PARKING STRUCTURE AND
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DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 230713 –
MECHANICAL INSULATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY

- A. Types of mechanical insulation specified in this section include the following:
 - 1. Piping Systems Insulation:
 - a. Fiberglass.
 - b. Cellular Glass.
 - c. Flexible Unicellular.
 - 2. Ductwork System Insulation:
 - a. Fiberglass.
 - 3. Equipment Insulation:
 - a. Fiberglass.
 - b. Cellular Glass.
 - c. Flexible Unicellular.
- B. Requirements of the following Division 15 sections apply to this section.
 - 1. Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS
 - 2. Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS
 - 3. Division 23, Section 0529 - HANGERS AND SUPPORTS
 - 4. Division 23, Section 230553 - MECHANICAL IDENTIFICATION
 - 5. Division 23, Section 233113 - METAL DUCTWORK

1.3 QUALITY ASSURANCE

- A. Labeling: Insulation shall be labeled by the manufacturer. The label shall include the insulating value, flame spread and smoke developed rating.
- B. Flame / Smoke Ratings: 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.
- C. Hot Surface Performance: Insulation coverings, jackets and linings shall not flame, glow, smolder or smoke when tested at their rated temperature in accordance with ASTM C411. Test temperature shall be 250 degrees F or greater.
- D. Testing: All testing shall be by UL or other testing or inspecting organization acceptable to the authority having jurisdiction.

1.4 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, density, thickness, and furnished accessories for each mechanical system requiring insulation.
- B. **Maintenance Data:** Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in Operating and Maintenance Manual.
- C. **Test Reports:** Submit material test reports prepared by a qualified independent testing laboratory. Certify insulation meets specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.
- C. Remove and replace any damaged or wet insulation with new materials. Remove damaged material from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
- B. **Manufacturer:** Subject to compliance with requirements, provide products of one of the following:
 - 1. **Fiberglass:**
 - a. Certaineed Corp.
 - b. Knauf Fiberglass GmbH.
 - c. Schuller International.
 - d. Owens-Corning Fiberglass Corp.
 - 2. **Cellular Glass:**
 - a. Pittsburgh Corning Corp.
 - 3. **Flexible Unicellular:**
 - a. Armstrong World Industries, Inc.
 - b. Rubatex Corp.
 - c. Imoca.
 - 4. **Calcium Silicate:**
 - a. Schuller International.
 - b. Owens-Corning Fiberglass Corp.
 - 5. **Adhesives, Mastics, Sealers and Cements:**
 - a. Armstrong World Industries, Inc.
 - b. Certaineed Corp.
 - c. Foster Products Corp.

- e. Knauf Fiberglass GmbH.
- f. Schuller International.
- g. Owens-Corning Fiberglass Corp.
- h. Pittsburgh Corning Corp.
- i. Rubatex Corp.
- j. King Co.

2.2 DUCTWORK INSULATION MATERIALS

- A. Fiberglass Blanket Insulation: Flexible, blanket duct insulation with jacket.
 - 1. Insulation shall comply with requirements of ASTM C553, Type I, Class B-2 for service up to 250 degrees F.
 - 2. Thermal conductivity (k) at 75 degrees F mean temperature shall be 0.27 maximum at labeled thickness and 0.25 maximum with material compressed 25 percent when tested in accordance with ASTM C177 or ASTM C518.
 - 3. Density shall be 1 lb/cu ft.
 - 4. Fiberglass blanket duct insulation installed indoors shall be jacketed with foil-scrim-kraft (FSK) facing.
 - a. Jacket shall be factory applied.
 - b. Water vapor permeance shall be 0.02 permeance inch maximum when tested in accordance with ASTM E96, Procedure A.
 - c. Beach puncture shall be 40 oz in/in tear minimum when tested in accordance with ASTM D781.
- B. Fiberglass Board Insulation: Rigid board duct insulation with jacket.
 - 1. Insulation shall comply with requirements of ASTM C612, Class 2 for service up to 450 degrees F.
 - 2. Thermal conductivity (k) at 75 degrees F mean temperature shall be 0.22 maximum when tested in accordance with ASTM C177 or ASTM C518.
 - 3. Density shall be 3 lbs/cu ft.
 - 4. Fiberglass board duct insulation installed indoors shall be jacketed with FSK facing.
 - a. Jacket shall be factory applied.
 - b. Water vapor permeance shall 0.02 permeance inch maximum when tested in accordance with ASTM E96, Procedure A.
 - c. Beach puncture shall be 40 oz in/in tear minimum when tested in accordance with ASTM D781.

2.3 EQUIPMENT INSULATION MATERIALS

- A. Fiberglass Blanket Insulation: Flexible, blanket equipment insulation.
 - 1. Insulation shall comply with requirements of ASTM C553, Type I, Class B-4 for service up to 350 degrees F.
 - 2. Thermal conductivity (k) at 75 degrees F mean temperature shall be 0.25 maximum at labeled thickness and 0.24 maximum with material compressed 25 percent when tested in accordance with ASTM C177 or ASTM C518.
 - 3. Density shall be 1-1/2 lbs/cu ft.
 - 4. Fiberglass blanket equipment insulation installed indoors shall be jacketed with all-purpose laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil complying with ASTM C921, Type I.
 - a. Jacket shall be field applied.
 - b. Water vapor permeance shall be 0.02 permeance inch maximum when tested in accordance with ASTM E96, Procedure A.

- c. Beach puncture shall be 50 oz in/in tear minimum when tested in accordance with ASTM D781.
 - d. Tensile strength shall be 35 lbs/in width minimum when tested in accordance with ASTM D828.
- B. Fiberglass Board Insulation: Rigid board equipment insulation.
 - 1. Insulation shall comply with requirements of ASTM C612, Class 2 for service up to 450 degrees F.
 - 2. Thermal conductivity (k) at 75 degrees F mean temperature shall be 0.22 maximum when tested in accordance with ASTM C177 or ASTM C518.
 - 3. Density shall be 3 lbs/cu ft.
 - 4. Fiberglass board equipment insulation installed indoors shall be jacketed with all-purpose laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil complying with ASTM C921, Type I.
 - a. Jacket shall be field applied.
 - b. Water vapor permeance shall be 0.02 permeance inch maximum when tested in accordance with ASTM E96, Procedure A.
 - c. Beach puncture shall be 50 oz in/in tear minimum when tested in accordance with ASTM D781.
 - d. Tensile strength shall be 35 lbs/in width minimum when tested in accordance with ASTM D828.
- C. Cellular Glass Insulation: Rigid equipment insulation.
 - 1. Insulation shall comply with requirements of ASTM C552, Type I or Type III for service up to 900 degrees F.
 - 2. Thermal conductivity (k) at 75 degrees F mean temperature shall be 0.33 maximum when tested in accordance with ASTM C177 or ASTM C518.
 - 3. Cellular glass equipment insulation installed indoors shall be jacketed with all-purpose laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil complying with ASTM C921, Type I.
 - a. Jacket shall be field applied.
 - b. Water vapor permeance shall be 0.02 permeance inch maximum when tested in accordance with ASTM E96, Procedure A.
 - c. Beach puncture shall be 50 oz in/in tear minimum when tested in accordance with ASTM D781.
 - d. Tensile strength shall be 35 lbs/in width minimum when tested in accordance with ASTM D828.
- D. Flexible Unicellular Insulation: Flexible sheet equipment insulation.
 - 1. Insulation shall comply with requirements of ASTM C534, Type II for service up to 220 degrees F.
 - 2. Thermal conductivity (k) at 75 degrees F mean temperature shall be 0.28 maximum when tested in accordance with ASTM C177 or ASTM C518.
- E. Calcium Silicate Insulation: Preformed, rigid block equipment insulation.
 - 1. Insulation shall comply with requirements of ASTM C533, Type I for service up to 1,200 degree F.
 - 2. Thermal conductivity (k) at 100 degrees F mean temperature shall be 0.36 maximum when tested in accordance with ASTM C177 or ASTM C518.
 - 3. Density shall be 15 lbs/cu ft.
 - 4. Flexural strength shall be 50 psi minimum when tested in accordance with ASTM C203.

5. Compressive strength shall be 160 psi to produce 5 percent compression of a 1-1/2-inch thick block.
6. Insulation shall be asbestos free.

2.4 INSULATING CEMENTS

- A. Mineral Fiber: ASTM C195.
 1. Thermal Conductivity: 1.0 average maximum at 500 degrees F mean temperature.
 2. Compressive Strength: 10 psi at 5 percent deformation.
- B. Expanded or Exfoliated Vermiculite: ASTM C196.
 1. Thermal Conductivity: 1.10 average maximum at 500 degrees F mean temperature.
 2. Compressive Strength: 5 psi at 5 percent deformation.
- C. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C449.
 1. Thermal Conductivity: 1.2 averages maximum at 400 degrees F mean temperature.
 2. Compressive Strength: 100 psi at 5 percent deformation.

2.5 ADHESIVES

- A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.
- B. Lagging Adhesive: MIL-A-3316C, nonflammable adhesive in the following classes and grades:
 1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
 2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.6 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.
 1. Tape Width: 4 inches.
 2. Cloth Standard: MIL-C-20079H, Type I.
 3. Tape Standard: MIL-C-20079H, Type II.
- B. Bands: 3/4-inch wide, in one of the following materials compatible with jacket:
 1. Stainless Steel: Type 304, 0.020 inch thick.
 2. Galvanized Steel: 0.005 inch thick.
 3. Aluminum: 0.020 inch thick.
 4. Brass: 0.01 inch thick.
 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 14-gauge nickel copper alloy, 16-gauge, soft-annealed stainless steel, or 16-gauge, soft-annealed galvanized steel.
- D. Corner Angles: 28-gauge, 1-inch by 1-inch aluminum, adhered to 2-inch by 2-inch kraft paper.

- E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.
- F. Aluminum Foil Tape: UL 181A-P.

2.7 SEALING COMPOUNDS

- A. Vapor Barrier Compound: Water-based, fire-resistive composition.
 - 1. Water Vapor Permeance: 0.08 perm maximum.
 - 2. Temperature Range: Minus 20 to 180 degrees F.
- B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.
 - 1. Water Vapor Permeance: 0.02 perm maximum.
 - 2. Temperature Range: Minus 50 to 250 degrees F.
 - 3. Color: Aluminum.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.
- B. Do not insulate pipes and ductwork until pressure and leak test have been completed and approved by Architect.

3.2 DUCTWORK SYSTEM INSULATION

- A. Application Requirements: Insulate all ductwork, fan and terminal unit collars, duct-mounted coils, diffuser and grille backs and plenums.
 - 1. Exhaust ducts within return air ceiling plenums or in conditioned spaces do not require insulation.
 - 2. Internally lined ductwork return air and transfer ductwork within return air ceiling plenums or in conditioned spaces do not require insulation.
- B. Mechanical Rooms: Ductwork within mechanical rooms shall have insulation thicknesses 1 thickness greater than that specified in the following paragraphs.
- C. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:
 - 1. Rigid Fiberglass: 2-inch thick for outdoor air duct exposed indoors.
 - 2. Flexible Fiberglass: 1-1/2-inch thick.
 - 3. Kitchen Hood Exhaust Duct: Calcium silicate, 2 inches thick.

3.3 INSTALLATION OF DUCTWORK INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier jacket on ductwork insulation, and protect it to prevent puncture and other damage. Seal all tears, punctures and other penetrations in insulation jacket.
- E. Rigid Fiberglass Insulation: Install using mechanical fasteners (weld pins or stick clips) located not less than 3 inches from edge or corner of insulation board. Pin spacing along duct shall be no greater than 12 inches on centers. Duct insulation board shall be impaled over pins and fasteners with self-locking washers. All joints shall be tight, with insulation lengths tightly butted against each other. Where lengths are cut, they shall be smooth and square without breakage of end surfaces. Where insulation terminates, the ends shall be neatly tapered and effectively sealed and finished. Longitudinal seams of exposed insulation shall be directed away from normal view. Apply a matching pressure-sensitive vapor seal patch over each pin and washer. All insulation edges and butt joints are to be sealed with pressure-sensitive joint sealing tape to match the jacket. Tape shall comply with UL 181A-P requirements. Use 3-inch wide tape on flat surfaces, or where edges are shiplapped and stapled. Five-inch wide tape can be used in lieu of shiplapping. Contours on exposed work shall be smooth and continuous. Cemented laps, flaps, bands and tapes shall be smoothly and securely pasted down.
- F. Flexible Fiberglass: Install insulation over a 50-percent coverage coat of UL-approved adhesive, applied to duct in 6-inch brush strokes, on 12-inch centers. Ducts 24 inches and larger in width or height shall have insulation additionally secured with mechanical fasteners (weld pins or stick clips) spaced on 18-inch centers (maximum) to prevent sagging of insulation. Insulation jacket shall be overlapped a minimum of 2 inches at all joints and seams then stapled 6 inches on center with outward clinching staples. All joints, seams and breaks in the vapor barrier shall be sealed with UL-approved mastic and 4-inch wide glass fabric.
- G. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where fire dampers are installed.
- H. Ductwork Exposed to Weather: Protect outdoor insulation from weather by outdoor jacketing as specified for piping above.
- I. Corner Angles: Provide corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.4 INSTALLATION OF EQUIPMENT INSULATION

- A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

- C. Maintain integrity of vapor-barrier jacket on equipment insulation and protect it to prevent puncture and other damage. Seal all tears, punctures and other penetrations in insulation jacket.
- D. Do not apply insulation to equipment, breechings, or stacks while hot.
- E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover fiberglass insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2 inches. Apply over vapor barrier where applicable.
- H. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal insulation covers, fasteners, flanges, frames and accessories.

Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish and aluminum jacketing. Install jacket with 2 – inch overlap, secured by aluminum bands 9 inches o.c.
- J. The insulation shall be installed so that it does not interfere with the functioning of flexible fittings.

3.5 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 230713

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DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 233113 –
METAL DUCTWORK**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. This section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus two (2) inches water gauge.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS.
 - 2. Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS.
 - 3. Division 23, Section 230713 - MECHANICAL INSULATION
 - 4. Division 23, Section 233300 - DUCT ACCESSORIES
 - 5. Division 23, Section 233713 – DIFFUSERS, REGISTERS AND GRILLES
 - 6. Division 23, Section 239993 - TESTING, ADJUSTING, AND BALANCING.

1.3 DEFINITIONS

- A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this section, the following definitions apply:
 - 1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
 - 2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Duct Liner.
 - 2. Sealing Materials.
 - 3. Firestopping Materials.
 - 4. Round and flat oval duct and fittings.
- C. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:
 - 1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 - 2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this section.
 - 3. Fittings.
 - 4. Reinforcing details and spacing.
 - 5. Seam and joint construction details.
 - 6. Penetrations through fire-rated and other partitions.
 - 7. Terminal unit, coil, and humidifier installations.
 - 8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- D. Coordination drawings for ductwork installation in accordance with Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS. In addition to the requirements specified in Section 230100, show the following:
 - 1. Coordination with ceiling suspension members.
 - 2. Spatial coordination with other systems installed in the same space with the duct systems.
 - 3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
 - 4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.
- E. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.
- F. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 23, Section 230100 - BASIC MECHANICAL, FIRE PROTECTION AND PLUMBING REQUIREMENTS and Division 1.

1.6 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."
- B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.

- C. NFPA Compliance: Comply with the following NFPA Standards:
 - 1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
- D. Field-Constructed Mock-Up: Prior to installation of duct systems erect mock-ups representing duct systems pressure classifications greater than 2 inches. Build mock-ups to comply with the following requirements, using materials indicated for final unit of work.
 - 1. Locate mock-ups on the site. Mock-up may be a representative section of the actual duct system.
 - 2. Include the minimum number of each of the following features and fittings:
 - a. Five transverse joints.
 - b. One access door.
 - c. Two typical branch connections each with at least one elbow.
 - d. Two typical flexible duct or flexible connector connections for each type duct and apparatus.
 - 3. Perform tests specified in "Field Quality Control." Modify mock-up construction and perform additional tests as required to achieve specified minimum acceptable results.
 - 4. Obtain approval of mock-ups before beginning final fabrication.
 - 5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of work.
 - 6. Demolish and remove mock-ups from Project site when directed.
 - 7. Accepted mock-ups that form a part of the actual duct system may remain and become part of completed unit of work.
- E. Construct all ductwork and accessories in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible" 2nd Edition, 1995.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials. Maintain copies of MSDS on site.
- B. Store and handle sealant fire-stopping materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- C. Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers' products which may be incorporated in the work include, but are not limited to the following:
- B. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - 1. Ductwork, Round and Flat Oval:

- a. Auto Duct.
- b. United McGill Corp.
- c. Semco.
- d. Sheet Metal Products Co.
- e. Monroe Metal Manufacturing Co.
- f. Spiral-Air.
- g. Spiral Pipe of Texas, Inc.
- h. Wesco.
- 2. Duct Sealers and Coatings:
 - a. Durkee-Atwood.
 - b. Hardcast, Inc.
 - c. United McGill Corp.
 - d. Foster Products Division, H.B. Fuller, Co.
 - e. King Co.
 - f. Porter Paint.
- 3. Duct Sealing Tape:
 - a. Durkee-Atwood.
 - b. Hardcast, Inc.
 - c. United McGill Corp.
- 4. Acoustical Duct Liners:
 - a. Knauf.
 - b. Certainteed Corp.
 - c. Owens-Corning.
 - d. Manville-Schuller.
- 5. Duct Liner, Adhesive:
 - a. Foster Products Division, H.B. Fuller, Co.
 - b. Manville-Schuller.
 - c. King Co.
- 6. Duct Liner, Mastic:
 - a. Foster Products Division, H.B. Fuller, Co.
 - b. Manville-Schuller.
 - c. King Co.

2.2 SHEET METAL MATERIALS

- A. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A700.
- B. Galvanized Sheet Steel: Lock-forming quality, ASTM A527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.
- C. PVC-Coated Galvanized Steel: UL-181 Class 1 Listing. Lock-forming quality galvanized sheet steel with ASTM A527, Coating Designation G 90. Provide with factory-applied, 4-mil, PVC coating on the exposed surfaces of ducts and fittings (exterior of ducts and fittings for underground applications, and the interior of ducts and fittings for fume-handling applications) and 2-mil PVC coating on the reverse side of the ducts and fittings.
- D. Carbon Steel Sheets: ASTM A366, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

- E. Stainless Steel: ASTM A480, Type 316, sheet form, with No. 4 finish on exposed surface for ducts exposed to view; Type 304, sheet form, with No. 1 finish for concealed ducts.
- F. Aluminum Sheets: ASTM B209, Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish where ducts are exposed to view, and mill finish for concealed ducts.
- G. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.
- H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 DUCT LINER

- A. General: Comply with NFPA Standard 90A and TIMA Standard AHC-101.
- B. Materials: ASTM C1071, Type II, with coated surface exposed to airstream to prevent erosion of glass fibers.
 - 1. Thickness: 1/2 inch.
 - 2. Thickness: 1 inch.
 - 3. Thickness: 1-1/2 inch.
 - 4. Density: 1-1/2 pounds.
 - 5. Density: 2 pounds.
 - 6. Density: 3 pounds.
 - 7. Thermal Performance: "K-Factor" equal to 0.28 or better, at a mean temperature of 75 degrees F.
 - 8. Fire Hazard Classification: Flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM C411.
 - 9. Liner Adhesive: Comply with NFPA Standard 90A and ASTM C916.
 - 10. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct. Provide fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.
 - a. Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.
 - b. Adhesive for Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.
 - 11. Coating: Acrylic cleanable coating factory formulated with an EPA registered antimicrobial growth-resistant agent in accordance with ASTM G21 and G22 test.

2.4 SEALING MATERIALS

- A. Joint and Seam Sealants, General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
 - 1. Duct Sealers: NFPA rating of "Non-Combustible."
 - a. Flame Spread Rating: 25 or lower, in dry condition.

- b. Smoke Developed Rating: 50 or lower, in dry condition.
 - c. Resistant to water and water vapors.
 - d. Pressure Rupture Rating: 16-inch water gauge, minimum.
- 2. Duct Sealing Tapes: NFPA rating of "Non-Combustible."
 - a. Flame Spread Rating: 25 or lower, in dry condition.
 - b. Smoke Developed Rating: 50 or lower, in dry condition.
 - c. Adhesive: Specifically compounded for maximum adhesion to galvanized and stainless steel.
- B. Joint and Seam Tape: 2 inches wide, glass-fiber-fabric reinforced.
- C. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic / silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.
- D. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 75 percent solids.
- E. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C920, Type S, Grade NS, Class 25, Use O.

2.5 FIRESTOPPING

- A. Refer to Division 7, JOINT SEALANTS for firestopping.

2.6 FIRESTOPPING

- A. Fire-Resistant Sealant: Provide two-part, foamed-in-place, fire-stopping silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
- D. Products: Subject to compliance with requirements, provide one of the following:
 - 1. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
 - 2. "Pensil 851"; General Electric Co.
 - 3. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
 - 4. "3M Fire Barrier Caulk CP-25"; Electrical Products Div. /3M.
 - 5. "RTV 7403"; General Electric Co.
 - 6. "Fyre Putty"; Standard Oil Engineered Materials Co.

2.7 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.
- B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.
 - 1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
 - 2. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, for sheet steel width and gauge and steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A36.
 - 1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
 - 2. For stainless steel ducts, provide stainless steel support materials.
 - 3. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.

2.8 RECTANGULAR DUCT FABRICATION

- A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-6 through 1-20, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.
 - 1. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
 - 2. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- B. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:
 - 1. Supply Ducts: 2 inches water gauge.
 - 2. Return Ducts: 2 inches water gauge, negative pressure.
 - 3. Exhaust Ducts: 1 inches water gauge, negative pressure.
- C. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 1-8, unless they are lined or are externally insulated.
- D. Button punch or snaplock seams not acceptable.

2.9 RECTANGULAR DUCT FITTINGS

- A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," Figures 2-1 through 2-11.
- B. Provide turning vanes as specified in Section 15920 in all rectangular nonradius elbows.

2.10 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness are prohibited.
- B. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
- E. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.
 - 1. Apply an adhesive coating on longitudinal seams in ducts exceeding 2,500 FPM air velocity.
- F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:
 - 1. Fan discharge.
 - 2. Intervals of lined duct preceding unlined duct.
 - 3. Upstream edges of transverse joints in ducts.
- H. Secure insulation liner with perforated sheet metal liner of the same gauge specified for the duct, secured to ducts with mechanical fasteners that maintain metal liner distance from duct without compressing insulation. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent.
- I. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.

2.11 ROUND AND FLAT OVAL DUCT FABRICATION

- A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.
- B. Round Ducts: Fabricate round supply ducts with spiral lockseam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gauges.
- C. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figure 3-1, RL-1, RL-4, or RL-5. Seams Types RL-2 or RL-3 may be used if spot-welded on 1-inch intervals. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gauges.
- D. Flat Oval Ducts: Fabricate flat oval supply ducts with standard spiral lockseams (without intermediate ribs) or with butt-welded longitudinal seams in gauges listed in SMACNA "HVAC Duct Construction Standards," Table 3-4.
- E. Double-Wall (Insulated) Ducts: Fabricate double-wall, insulated ducts with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions.
 - 1. Thermal Conductivity: 0.27 Btu/sq. ft. /degrees F/inch thickness at 75 degrees F mean temperature.
 - 2. Outer Shell: Base outer shell gauge on actual outer shell dimensions. Provide outer shell lengths 2 inches longer than inner shell and insulation, and in gauges specified above for single-wall duct.
 - 3. Insulation: Unless otherwise indicated, provide 1-inch-thick fiber-glass insulation. Coat insulation with acrylic cleanable coating, factory formulated with an EPA registered, antimicrobial growth agent in accordance with ASTM G21 and G22 test. Provide insulation ends where internally insulated duct connects to single-wall duct or noninsulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the inner liner diameter.
 - 4. Solid Inner Liner: Construct round and flat oval inner liners with solid sheet metal of the gauges listed below. For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."
 - 5. Perforated Inner Liner: Construct round and flat oval inner liners with perforated sheet metal of the gauges listed below. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent. For flat oval ducts, the diameter indicated below is the "basic round diameter."
 - a. 3 to 8 inches: 28 gauge with standard spiral construction.
 - b. 9 to 42 inches: 28 gauge with single-rib spiral construction.
 - c. 44 to 60 inches: 26 gauge with single-rib spiral construction.
 - d. 62 to 88 inches: 22 gauge with standard spiral construction.
 - 6. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

2.12 ROUND AND FLAT OVAL SUPPLY AND EXHAUST FITTINGS FABRICATION

- A. 90-Degree Tees, Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," Figures 3-4 and 3-5 and with metal thicknesses specified for longitudinal seam straight duct.

- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:
 - 1. Mitered Elbows: Fabricate mitered elbows with continuously welded construction in gauges specified below.
 - a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," Table 3-1.
 - b. Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.
 - c. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vanes.
 - 2. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degrees elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.
 - 3. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.
 - 4. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.
 - 5. Die-Formed Elbows for Sizes through 8 Inches and All Pressures: 20 gauge with 2-piece welded construction.
- D. Double-Wall (Insulated) Fittings: Fabricate double-wall, insulated fittings with an outer shell, insulation, and an inner liner as specified for ductwork above. Dimensions indicated on internally insulated ducts are nominal inside dimensions.
- E. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:
 - 1. Round Elbows 4 to 8 Inches: 2-piece die-stamped, with longitudinal seams spot welded, bonded, and painted with a PVC aerosol spray.
 - 2. Round Elbows 9 to 26 Inches: Standing seam construction.
 - 3. Round Elbows 28 to 60 Inches: Standard gore construction, riveted and bonded.
 - 4. Other Fittings: Riveted and bonded joints.
 - 5. Couplings: Slip-joint construction with a minimum of a 2-inch insertion length.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.

- B. Install ducts with the fewest possible joints.
- C. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.
- D. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
- E. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- H. Install insulated ducts with 1-inch clearance outside of insulation.
- I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
- J. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

3.2 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-9. Make necessary provision for local seismic conditions for St. George, Utah.
- B. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.
- E. Install concrete insert prior to placing concrete.
- F. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.3 CONNECTIONS

- A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23, Section 233300 - DUCT ACCESSORIES.
- B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-5 and 2-6, using only 45-degree or conical taps.
- C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-14 through 2-16.
- D. Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-19.

3.4 FIELD QUALITY CONTROL

- A. The Owner will contract with an independent testing agency to perform, record, and report leakage tests.
- B. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.

3.5 FIELD QUALITY CONTROL

- A. Disassemble, reassemble, and seal segments of the systems as required to accommodate leakage testing, and as required for compliance with test requirements.
- B. Conduct tests, in the presence of the Architect, of ductwork constructed of 4-inch pressure class or greater, at static pressures equal to the maximum design pressure of the system or the section being tested. If pressure classifications are not indicated, test entire system at the maximum system design pressure. Do not pressurize systems above the maximum design operating pressure. Give 7 days' advanced notice for testing.
- C. Determine leakage from entire system or section of the system by relating leakage to the surface area of the test section.
- D. Maximum Allowable Leakage: As described in ASHRAE 1993 Handbook, "Fundamentals" Volume, Chapter 32, Tables 6, 7 and Figure 10. Comply with requirements for leakage classification 3 for round and flat oval ducts, leakage classification 12 for rectangular ducts in pressure classifications less than and equal to 2 inches water gauge (both positive and negative pressures), and leakage classification 6 for pressure classifications greater than 2 inches water gauge and less than and equal to 10 inches water gauge.
- E. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.

3.6 ADJUSTING AND CLEANING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required airflow. Refer to Division 23, Section 239993 - TESTING,

ADJUSTING, AND BALANCING for requirements and procedures for adjusting and balancing air systems.

- B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 233113

**DULUTH PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 233300
DUCT ACCESSORIES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. This section includes the following:
 - 1. Backdraft dampers.
 - 2. Manual volume control dampers.
 - 3. Fire and smoke dampers.
 - 4. Actuators.
 - 5. Duct silencers.
 - 6. Turning vanes.
 - 7. Duct-mounted access doors and panels.
 - 8. Flexible connectors.
 - 9. Flexible ducts.
 - 10. Accessories hardware.
 - 11. Gravity roof ventilators.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS.
 - 2. Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS.
 - 3. Division 23, Section 230713 - MECHANICAL INSULATION
 - 4. Division 23, Section 233300 - DUCT ACCESSORIES
 - 5. Division 23, Section 233713 – DIFFUSERS, REGISTERS AND GRILLES
 - 6. Division 23, Section 239993 - TESTING, ADJUSTING, AND BALANCING

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data including details for materials, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Backdraft dampers.
 - 2. Manual volume control dampers.
 - 3. Fire and smoke dampers.
 - 4. Duct-mounted access panels and doors.
 - 5. Duct silencers.
 - 6. Flexible ducts.
 - 7. Gravity roof ventilators.

- C. Shop drawings from manufacturer detailing assemblies. Include dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail the following:
 - 1. Special fittings and volume control damper installation (both manual and automatic) details.
 - 2. Fire and smoke damper installations, including sleeves and duct-mounted access door and panel installations.
- D. Product Certification: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static pressure loss, and dimensions and weights.

1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA Standards:
 - 1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

1.5 EXTRA MATERIALS

- A. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include, but are not limited to, the following:
- B. Manufacturer: Subject to compliance with requirements, provide duct accessories of one of the following:
 - 1. Backdraft Dampers:
 - a. Ruskin Manufacturing Co.
 - b. Air Balance, Inc.
 - c. American Warming & Ventilating Co.
 - d. Carnes.
 - e. Cesco.
 - f. Penn Ventilator Co.
 - g. Prefco Products, Inc.
 - h. Safe-Air, Inc.
 - 2. Manual Dampers:
 - a. Ruskin Manufacturing Co.
 - b. Air Balance, Inc.
 - c. American Warming & Ventilating Co.
 - d. Carnes.
 - e. Krueger.

- f. Penn Ventilator Co.
- g. Prefco Products, Inc.
- h. Safe-Air, Inc.
- i. Vent Products, Co.
- 3. Fire and Smoke Dampers:
 - a. Air Balance, Inc.
 - b. Ruskin Manufacturing Co.
 - c. American Warming & Ventilating Co.
 - d. Arrow United Industries, Inc.
 - e. Nailor-Hart Industries, Inc.
 - f. National Controlled Air.
 - g. Phillips-Aire.
 - h. Prefco Products, Inc.
 - i. Safe-Air, Inc.
 - j. Vent Products, Co.
- 4. Duct Silencers:
 - a. Industrial Acoustics (IAC).
 - b. United McGill Corp.
 - c. Vibro-Acoustics.
- 5. Turning Vanes:
 - a. Aero-Dyne.
 - b. Airsan.
 - c. Tuttle and Bailey.
 - d. Titus.
 - e. Vent Products Co.
- 6. Access Doors:
 - a. Air Balance, Inc.
 - b. American Warming & Ventilating Co.
 - c. Nailor-Hart Industries, Inc.
 - d. Prefco Products, Inc.
 - e. Ruskin.
 - f. United McGill Corp.
 - g. Ventfabrics.
 - h. Zurn Industries, Inc.
- 7. Flexible Fan Connections:
 - a. Duro-Dyne.
 - b. Elgin.
 - c. Ventfabrics.
- 8. Flexible Duct:
 - a. Acme Manufacturing Co. CertainTeed Corp.
 - b. Clevepak Corp., Clevaflex Division.
 - c. General Flex Corp.
 - d. Goodman Manufacturing Corp.
 - e. Flexible Technologies, Automation Industries, Inc.
 - f. H.K. Porter Co., Inc., Thermoid Division.
 - g. The Wiremold Co., Flexible Systems Group.
- 9. Gravity Roof Ventilators:
 - a. Carnes.
 - b. ACME Engineering and Manufacturing, Inc.
 - c. Loren Cook Co.
 - d. Greeheck.
 - e. Aerovent, Inc.
 - f. Penn Ventilator Co.

2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installation.
- B. Frame: 18-gauge galvanized steel, with welded corners and mounting flange.
- C. Frame: 18-gauge galvanized steel, with welded corners.
- D. Frame: 0.063-inch-thick 6063T extruded aluminum, with mounting flange.
- E. Frame: 0.063-inch-thick 6063T extruded aluminum.
- F. Blades: 0.025-inch-thick roll-formed aluminum.
- G. Blades: 0.050-inch-thick 6063T extruded aluminum.
- H. Blade Seals: Felt.
- I. Blade Seals: Vinyl.
- J. Blade Seals: Neoprene.
- K. Blade Axles: Nonferrous.
- L. Blade Axles: Galvanized steel.
- M. Tie Bars and Brackets: Aluminum.
- N. Tie Bars and Brackets: Galvanized steel.
- O. Return Spring: Adjustable tension.
- P. Chain Operator: 15-foot-long galvanized-steel sash chain and pulley.
- Q. Wing-Nut Operator: Galvanized steel, with 1/4-inch galvanized-steel rod.

2.3 MANUAL VOLUME CONTROL DAMPERS

- A. General: Provide factory-fabricated volume-control dampers, complete with required hardware and accessories. Stiffen damper blades to provide stability under operating conditions. Provide locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class. Provide end bearings or other seals for ducts with pressure classifications of 3 inches or higher. Extend axles full length of damper blades. Provide bearings at both ends of operating shaft.
- B. Standard Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside of air stream, and suitable for horizontal or vertical applications.
- C. Standard Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized-steel channels, minimum of 16 gauge, and with mitered and welded corners. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.
 2. Aluminum Frames: Hat-shaped, 0.063-inch-thick, 6063T extruded aluminum channels. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.
 3. Roll-Formed Steel Blades: 16-gauge, galvanized steel.
 4. Roll-Formed Aluminum Blades: 0.025-inch-thick roll-formed aluminum.
 5. Extruded Aluminum Blades: 0.050-inch-thick 6063T extruded aluminum.
 6. Blade Axles: Nonferrous.
 7. Blade Axles: Galvanized steel.
 8. Tie Bars and Brackets: Aluminum.
 9. Tie Bars and Brackets: Galvanized steel.
 10. Provide Type C housing for installation in round ductwork.
 11. Round Dampers: Butterfly type with 20-gauge circular blade mounted to 3/8-inch square axle, with self-lubricating nylon bearings in a 20-gauge galvanized steel sleeve.
 - a. Use only where indicated.
 - b. Shop or field assembled dampers not acceptable.
 - c. Ruskin MDRS-25.
- D. Low-Leakage Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside of air stream, and suitable for horizontal or vertical applications.
- E. Low-Leakage Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized-steel channels, minimum of 16 gauge, and with mitered and welded corners. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.
 2. Aluminum Frames: Hat-shaped, 0.063-inch-thick, 6063T extruded aluminum channels. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.
 3. Roll-Formed Steel Blades: 16-gauge, galvanized steel.
 4. Roll-Formed Aluminum Blades: 0.025-inch-thick roll-formed aluminum.
 5. Extruded Aluminum Blades: 0.050-inch-thick 6063T extruded aluminum.
 6. Blade Seals: Felt.
 7. Blade Seals: Vinyl.
 8. Blade Seals: Neoprene.
 9. Blade Axles: Nonferrous.
 10. Blade Axles: Galvanized steel.
 11. Tie Bars and Brackets: Aluminum.
 12. Tie Bars and Brackets: Galvanized steel.
- F. High-Performance Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside of air stream, and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized-steel channels, minimum of 16 gauge, and with mitered and welded corners. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.

2. Aluminum Frames: Hat-shaped, 0.125-inch-thick, 6063T extruded aluminum channels. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.
 3. Steel Blades: 18-gauge, airfoil-shaped, galvanized steel.
 4. Extruded Aluminum Blades: 0.081-inch-thick minimums, 6063T extruded aluminum.
 5. Blade Seals: Dual-durometer vinyl on blade edges; metallic compression on jambs.
 6. Blade Axles: Nonferrous.
 7. Blade Axles: Galvanized steel.
 8. Tie Bars and Brackets: Aluminum.
 9. Tie Bars and Brackets: Galvanized steel.
- G. Jackshaft: 1-inch-diameter, galvanized-steel pipe rotating within a pipe bearing assembly mounted on supports at each mullion and at each end of multiple damper assemblies. Provide appropriate length and number of mounting to connect linkage of each damper of a multiple damper assembly.
- H. Damper Control Hardware: Zinc-plated, die-cast core with a heavy-gauge dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Provide center hole to suit damper operating rod size. Provide elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

- A. General: UL labeled according to UL Standard 555 "Standard for Fire Dampers." Refer to Fire Damper Schedule at the end of this section.
- B. Fire Rating: 1-1/2 or 3 hours, as indicated.
- C. Frame: Type A or Type B; fabricated with roll-formed, 21-gauge, galvanized-steel; with mitered and interlocking corners.
- D. Mounting Sleeve: Factory-installed or field-installed galvanized steel.
1. Minimum Thickness: 0.056-inch (16-gauge) or 0.138-inch (10-gauge) thick as indicated, and length to suit application.
 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of the wall or floor, and thickness of damper frame meets sleeve requirements.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed, interlocking, 21-gauge galvanized steel. In place of interlocking blades, provide full-length, 21-gauge, galvanized-steel blade connectors.
- G. Horizontal Dampers: Include a blade lock and stainless steel negator closure spring.
- H. Fusible Link: Replaceable, 165 degrees F or 212 degrees F rated as indicated.

2.5 CEILING FIRE DAMPERS

- A. General: UL listed and labeled; comply with the construction details for the tested floor / roof-ceiling assemblies as indicated in the UL Fire Resistance Directory.

- B. Frame: 20-gauge, rectangular or round, galvanized steel; style to suit ceiling construction.
- C. Blades: 22-gauge galvanized steel with nonasbestos refractory insulation.
- D. Volume Control Adjustment: Provide UL-labeled, fusible volume control adjustment.
- E. Fusible Link: Replaceable, 165 degrees F rated.
- F. Fusible Link: Replaceable, 212 degrees F rated.
- G. Fusible Link: Replaceable, 285 degrees F rated.

2.6 SMOKE DAMPERS

- A. General: UL-labeled according to UL Standard 555S, "Standard for Leakage Rated Dampers for Use in Smoke Control Systems." Combination fire and smoke dampers shall also be UL-labeled for 1-1/2 hour rating according to UL Standard 555 "Standard for Fire Dampers." Refer to the Smoke Damper Schedule at the end of this section for leakage classification, temperature category, and other characteristics.
- B. Fusible Link: Replaceable, 165 degrees F or 212 degrees F rated as indicated.
- C. Frame and Blades: 16-gauge galvanized steel.
- D. Mounting Sleeve: Factory-installed, 18-gauge, galvanized steel, length to suit wall or floor application.

2.7 ACTUATORS

- A. Damper Motors: Provide motors for smooth modulating or 2-position action.
 - 1. Permanent-Split-Capacitor or Shaded-Pole Motors: Provide with oil-immersed and sealed gear trains.
 - 2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 inch-pounds and breakaway torque rating of 150 inch-pounds.
 - 3. Outdoor Motors and Motors in Outside Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 degrees F (minus 40 degrees C).
 - 4. Non-Spring Return Motors: For dampers larger than 25 square feet, size motor for running torque rating of 150 inch-pounds and breakaway torque rating of 300 inch-pounds.
 - 5. 2-Position Motor: 115 V, single phase, 60 Hz.
 - 6. 2-Position Motor: 230 V, single phase, 60 Hz.
 - 7. 2-Position Motor: 230 V, 3 phase, 60 Hz.
 - 8. 2-Position Motor: 460 V, 3 phase, 60 Hz.
 - 9. Modulating, Spring Return Motor: 115 V, single phase, 60 Hz.
 - 10. Modulating, Spring Return Motor: 230 V, single phase, 60 Hz.
 - 11. Modulating, Spring Return Motor: 230 V, 3 phase, 60 Hz.
 - 12. Modulating, Spring Return Motor: 460 V, 3 phase, 60 Hz.

2.8 TURNING VANES

- A. Fabricate turning vanes according to SMACNA HVAC Duct Construction Standards, Figures 2-2 through 2-7.
- B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch-wide, curved blades set at 3/4 inch on center, support with bars perpendicular to blades set at 2 inches on center, and set into side strips suitable for mounting in ducts.
 - 1. Provide turning vanes in all nonradius elbows, supply, exhaust or return.
- C. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fiberglass fill.

2.9 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Refer to the Access Door Materials Schedule at the end of this section for frame and door thickness, number of hinges and locks, and location of locks. Provide construction and airtightness suitable for duct pressure class.
- B. Frame: Galvanized sheet steel. Provide with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized sheet metal construction with insulation fill and thickness, number of hinges and locks as indicated for duct pressure class. Provide vision panel where indicated. Provide 1-inch by 1-inch butt hinge or piano hinge and "Ventlock" lever handles.
 - 1. Sash or cam locks not acceptable.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber seals.
- E. Insulation: 1-inch thick fiberglass or polystyrene foam board.

2.10 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL Standard 181, Class 1.
 - 1. Provide at all unit connections, all building expansion joints and where indicated.
- B. Standard Metal-Edged Connectors: Factory-fabricated with a strip of fabric 3-1/2 inches wide attached to 2 strips of 2-3/4-inch-wide, 24-gauge, galvanized sheet steel or 0.032-gauge aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.
- C. Extra-Wide Metal-Edged Connectors: Factory-fabricated with a strip of fabric 5-3/4 inches wide attached to 2 strips of 2-3/4-inch-wide, 24-gauge, galvanized sheet steel or 0.032-gauge aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.
- D. Transverse Metal-Edged Connectors: Factory-fabricated with a strip of fabric 3-1/2 inches wide attached to 2 strips of 4-3/8-inch-wide, 24-gauge, galvanized sheet steel or 0.032-gauge aluminum sheets. Select metal compatible with connected duct

system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.

- E. Conventional, Indoor System Flexible Connectors Fabric: Glass fabric double coated with polychloroprene.
 - 1. Minimum Weight: 26 oz. per sq yd.
 - 2. Tensile Strength: 480 lb per inch in the warp and 360 lb per inch in the filling.
- F. Conventional, Outdoor System Flexible Connectors Fabric: Glass fabric double coated with DuPont's HYPALON or other synthetic-rubber weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
 - 1. Minimum Weight: 26 oz. per sq yd.
 - 2. Tensile Strength: 530 lb per inch in the warp and 440 lb per inch in the filling.
 - 3. High-Temperature System Flexible Connectors: Glass fabric coated with silicone rubber and having a minimum weight of 16 oz. per sq yd and tensile strength of 285 lb per inch in the warp, and 185 lb per inch in the filling.
 - 4. High-Corrosive-Environment System Flexible Connectors: Glass fabric coated with a chemical-resistant coating.
 - 5. Minimum Weight: 14 oz. per sq yd.
 - 6. Tensile Strength: 450 lb per inch in the warp and 340 lb per inch in the filling.

2.11 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
 - 1. Flame spread of 25 or less, smoke developed not to exceed 50.
 - 2. Rated Working Pressure: Positive 8-inch WG, negative 1-1/2-inch WG.
- B. Flexible Ducts - Uninsulated: Spiral-wound steel spring with flameproof vinyl sheathing.
- C. Flexible Ducts - Uninsulated: Corrugated aluminum.
- D. Flexible Ducts - Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch-thick, glass fiber insulation around a continuous inner liner.
 - 1. Reinforcement: Steel-wire helix encapsulated in the inner liner.
 - 2. Outer Jacket: Glass-reinforced, silver mylar with a continuous hanging tab, integral fiber glass tape, and nylon hanging cord.
 - 3. Outer Jacket: Polyethylene film.
 - 4. Inner Liner: Polyethylene film.
 - 5. Thermal Conductance (C): 0.023.
- E. Connections: Secure flexible duct to collar or sleeve with duct sealer and 1/2-inch clamps. Secure insulation cover with 2 wraps of duct tape.
- F. Maximum Length: Air outlets 6 feet, 0 inches; terminal unit inlets 2 feet, 0 inches.

2.12 ACCESSORIES HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket and a flat mounting gasket. Size to allow insertion of pitot tube and other testing instruments and provide in length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket, 1/4-inch, zinc-plated operating rod, and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless steel band with cadmium-plated hex screw to tighten band with a worm-gear action. Provide in sizes from 3 to 18 inches to suit duct size.
- D. Duct Sealer and Adhesives: As specified in Division 15, Section 15891 - METAL DUCTWORK.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of duct accessories. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install duct accessories according to manufacturer's installation instructions and applicable portions of details of construction as shown in SMACNA standards.
- B. Install volume control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to the manufacturer's UL-approved printed instructions.
- E. Install fusible links in fire dampers.
- F. Label access doors according to Division 23, Section 230553 - MECHANICAL IDENTIFICATION.
- G. Install flexible duct with turn radius not less than R/D equal to 1.0. Provide supports per Figures 3-9 and 3-10, SMACNA HVAC Duct Construction Standards.
 - 1. Maximum Length: Air outlets 6 feet, 0 inches; terminal unit inlets 2 feet, 0 inches.
 - 2. Install access doors at each fire damper, duct mounted controller and other items requiring access and service.
- H. Install manufactured turning vanes in each nonradius elbow.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual dampers is specified in Division 15, Section 15990 - TESTING, ADJUSTING, AND BALANCING.

ACCESS DOOR MATERIALS SCHEDULE

| DUCT PRESSURE CLASS | DOOR SIZE INCHES | NUMBER OF HINGES | NUMBER OF LOCKS | METAL GAGE FRAME | METAL GAGE DOOR | BACK |
|---------------------------|------------------------|------------------------|-----------------------|------------------------|-----------------------|------|
| 2 INCHES & LESS | 12X12 | 2 | 1-S | 24 | 26 | 26 |
| | 16x20 | 2 | 2-S | 22 | 24 | 26 |
| | 24X24 | 3 | 2-S | 22 | 22 | 26 |
| 3 INCHES | 12X12 | 2 | 1-S | 22 | 22 | 26 |
| | 16X20 | 2 | 1-S, 1-T, 1-B | 20 | 20 | 26 |
| | 24X24 | 3 | 2-S, 1-T, 1-B | 20 | 20 | 24 |

S: SIDE
T: TOP
B: BOTTOM

END OF SECTION 233300

**NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 233423
POWER VENTILATORS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including GENERAL CONDITIONS, SUPPLEMENTARY CONDITIONS and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. This section includes the following:
 - 1. Square In-line centrifugal fans.
 - 2. Packaged propeller wall fans.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 23, Section 230548 - VIBRATION CONTROL for vibration hangers and supports.
 - 2. Division 26, section for - SAFETY SWITCHES for disconnect switches.
 - 3. Division 26, section for - PANELBOARDS for circuit breakers.
 - 4. Division 26, section for - INDIVIDUALLY MOUNTED MOTOR CONTROLLERS for motor starters.
- C. Products furnished, but not installed, under this section include roof curbs for roof-mounted exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on sea-level conditions.
- B. Operating Limits: Classify according to AMCA 99.
- C. Fan Unit Schedule: The following information is described in an equipment schedule at the end of this section.
- D. Fan Unit Schedule: The following information is described in an equipment schedule on the Drawings.
 - 1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
 - 2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

- B. Product Data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound power ratings.
 - 3. Motor ratings and electrical characteristics plus motor and electrical accessories.
 - 4. Material gages and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
- C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
- D. Coordination Drawings for all fans to include wall penetration requirements drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:
 - 1. Wall framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
- E. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
- F. Maintenance data for power ventilators to include in the operation and maintenance manual specified in Division 1.

1.5 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available. Unless indicated otherwise on the drawings each fan shall be provided with a NEC approved power disconnect and starter. Refer to fans that require speed controllers.
- B. Listing and Labeling: Provide electrically operated fixtures specified in this section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.
- D. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.
- E. UL Standard: Provide power ventilators that comply with UL 705.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements. Verify clearances.

- B. Do not operate fans until ductwork is clean, bearings are lubricated, and fans have been commissioned.

1.7 COORDINATION AND SCHEDULING

- A. Coordinate the size and location of structural steel support members.
- B. Coordinate the installation of wall sleeves, equipment supports, and wall penetrations.

1.8 EXTRA MATERIALS

- A. Furnish one set of belts for each belt-driven fan that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. In-Line Centrifugal Fans:
 - a. Cook (Loren) Co.
 - b. Carnes Co.
 - c. Greenheck Fan Corp.
 - d. Penn Ventilator.
 - 2. Propeller Wall Fans:
 - a. Cook (Loren) Co.
 - b. Carnes Co.
 - c. Greenheck Fan Corp.
 - d. Penn Ventilator.

2.2 SQUARE IN-LINE CENTRIFUGAL FANS

- A. Description: Fan shall be duct mounted, belt driven centrifugal square In-line consisting of housing, wheel, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, back draft damper, vibration isolators flex duct connectors and accessories.
- B. Housing: Fan housing shall be minimum 18 gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gaskets. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation.
- C. Belt-Driven Units: Belts shall be oil and heat resistant, non-static type. Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

- D. Fan Wheels: Wheel shall be centrifugal backward inclined, constructed of 100% aluminum. Wheel shall be balanced in accordance with AMCA Standard 204-9.
- F. Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Accessories: The following accessories are required as indicated:
 - 1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 - 2. Companion Flanges: For inlet and outlet duct connections.
 - 3. Fan Guards: Expanded metal in removable frame. Provide belt guards for units not connected to ductwork.

2.3 PACKAGED PROPELLER WALL FANS

- A. Description: Fan shall be a wall mounted, direct driven, aluminum propeller exhaust fan with integral housing, discharge air weather resistant shutter, inlet duct flanged connection, disconnect switch, fan speed controller, insect screen, wall mounting flange.
- B. Housing: Fan shall be enclosed in minimum 18 gauge galvanized steel wall housing with factory installed shutter. Fan shall be bolted and welded construction utilizing corrosion resistant fasteners.
- C. Propeller: Fan propeller shall have aluminum blades riveted to a painted steel hub. The hub shall be securely fastened to the motor shaft utilizing two setscrews. Fan propeller shall be balanced in accordance with AMCA Standard 204-96.
- D. Motor: Motor shall be 120/1/60, open drip proof motor.
- E. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.

2.5 MOTORS

- A. Refer to Division 23, Section 230513 - MOTORS for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
- C. Enclosure Type: The following features are required as indicated:
 - 1. Open drip proof motors where satisfactorily housed or remotely located during operation.
 - 2. Guarded drip proof motors where exposed to contact by employees or building occupants.

2.6 FACTORY FINISHES

- A. Sheet Metal Parts: Prime coat before final assembly.
- B. Exterior Surfaces: Baked-enamel finish coat after assembly.

- C. Aluminum Parts: No finish required.

2.7 SOURCE QUALITY CONTROL

- A. Testing Requirements: The following factory tests are required as indicated:
 1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA Seal.
 2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install power ventilators according to manufacturer's written instructions.
- B. Support units using the vibration-control devices indicated. Vibration-control devices are specified in Division 23, Section 230548 - VIBRATION CONTROL.
 1. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.
 2. Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.
 3. Ceiling Units: Suspend units from structure using steel wire or metal straps.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 23, Section 230553 - MECHANICAL IDENTIFICATION.

3.3 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
- B. Electrical: Conform to applicable requirements in Division 26 sections.
- C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fans, including duct and electrical connections, and to report results in writing.

3.5 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

3.6 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.7 COMMISSIONING

- A. Final Checks before Startup: Perform the following operations and checks before startup:
 - 1. Verify that shipping-blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and those connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this section.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Lubricate bearings and other moving parts with factory-recommended lubricants.
 - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
 - 7. Disable automatic temperature-control operators.
- B. Starting procedures for fans are as follows:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - 2. Measure and record motor voltage and amperage.
- C. Shut unit down and reconnect automatic temperature-control operators.
- D. Refer to Division 23, Section 239993 - TESTING, ADJUSTING, AND BALANCING for procedures for air-handling-system testing, adjusting, and balancing.
- E. Replace fan and motor pulleys as required to achieve design conditions.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- B. Review data in the operation and maintenance manuals. Refer to Division 1, CONTRACT CLOSEOUT section.
- C. Schedule training with Owner, through Architect, with at least 7 days advance notice.
- D. Demonstrate operation of power ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each power ventilator.

END OF SECTION 233423

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**SECTION 233713 – DIFFUSERS
REGISTERS AND GRILLES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of outlets and inlets required for project include the following:
 - 1. Linear Bar Diffusers
 - 2. Ceiling air diffusers.
 - 3. Wall registers and grilles.
- C. Related Sections: The following sections contain requirements that relate to this section.
 - 1. Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS.
 - 2. Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS.
 - 3. Division 23, Section 233113 - METAL DUCTWORK.
 - 4. Division 23, Section 233300 - DUCT ACCESSORIES.
 - 5. Division 23, Section 239993 - TESTING, ADJUSTING AND BALANCING.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Codes and Standards:
 - 1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets."
 - 2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets."
 - 3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters."
 - 4. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
 - 5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.
- B. Shop Drawings: Submit manufacturer's assembly type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver air outlets and inlets wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include, but are not limited to, the following:
- B. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:
1. Diffusers, Registers and Grilles:
 - a. Tuttle and Bailey.
 - b. Titus.
 - c. Metal Aire.

2.2 AIR OUTLETS AND INLETS – GENERAL

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers and wall grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide ceiling air diffusers and wall grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling / Wall Compatibility: Provide diffusers and grilles with border styles that are compatible with adjacent ceiling and wall systems, and that are specifically

manufactured to fit into ceiling module or wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling and wall systems which will contain each type of ceiling air diffuser and wall grille.

2.3 CEILING AIR DIFFUSERS

- A. Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule.
1. Diffuser Faces:
 - a. Round: Round housing, core of concentric rings, round duct connection.
 - b. Half-Round: Semi-circular housing, core of concentric half-rings, rectangular duct connection.
 - c. Square: Square housing, core of square concentric louvers, square or round duct connection.
 - d. Rectangular: Rectangular housing, core of rectangular concentric louvers, square or round duct connection.
 - e. Panel: Square or rectangular housing extended to form a panel to fit in ceiling system module, core of square or rectangular concentric louvers, square or round duct connection.
 - f. Perforated: Round, square, or rectangular housing covered with removable perforated panel in frame. Conceal air pattern devices above panel.
 2. Diffuser Mountings:
 - a. Stepped-Down: Diffuser housing below ceiling with perimeter flange and gasket to seal against ceiling construction.
 - b. Flush: Diffuser housing above ceiling surface with flush perimeter flange and gasket to seal against ceiling.
 - c. Lay-In: Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.
 - d. Snap-In: Diffuser housing sized to fit between ceiling concealed suspension runners, and snap into runners.
 3. Diffuser Patterns:
 - a. Fixed: Fixed position core with concentric rings or louvers for radial airflow around entire perimeter of diffuser.
 - b. 2 Position: Manual 2-position core with concentric rings or louvers, upper position for horizontal airflow, lower position for vertical air flow.
 - c. Adjustable: Manual adjustable core with concentric rings or louvers, fully adjustable for horizontal to vertical airflow.
 - d. Supply and Return: 2-section core, center position for return, perimeter for supply.
 - e. 1 Way: Fixed louver face for 1-direction airflow, direction indicated on drawings.
 - f. 2 Way: Fixed louver face for 2-direction airflow, directions indicated on drawings.
 - g. 3 Way: Fixed louver face for 3-direction airflow, directions indicated on drawings.
 - h. 4 Way: Fixed louver face for 4-direction airflow, directions indicated on drawings.
 - i. Induction: Internal aspirator designed to mix air drawn into center core with conditioned air.
 - j. Rearrangeable Core: Modular directional core which can be rearranged for selected air pattern.

4. Diffuser Accessories:
 - a. Equalizing Deflectors: Adjustable parallel blades in frame for straightening air flow.
 - b. Smudge Ring: Extension perimeter frame around diffuser, sized so induced air impinges on frame and not on ceiling.
 - c. Plaster Ring: Perimeter ring designed to act as a plaster stop and diffuser anchor.
 - d. Extractor: Curved blades mounted on adjustable frame to produce air-scooping action in duct at diffuser take-off.
 - e. Blank-Off Baffles: Arc segments designed to fit into diffuser housing to divert airflow from impinging on obstruction.
 - f. Operating Keys: Tools designed to fit through diffuser face and operate pattern adjustment.
5. Diffuser Finishes:
 - a. Aluminum Enamel: Air-dried aluminum enamel prime finish.
 - b. White Enamel: Semi-gloss white enamel prime finish.
 - c. Aluminum Anodize: Aluminum etched and anodized, covered with clear lacquer finish.
 - d. Paint inside of perforated face air devices black.

2.4 LINEAR BAR DIFFUSERS

- A. Provide linear bar diffusers of the length and configuration indicated on the drawings.
- B. Fixed Pattern: All deflection bars are fixed; 0° deflection, and parallel to the long dimension. Fixed bars and support bars shall be extruded aluminum
- C. Volume Dampers: Opposed blade damper shall be constructed of heavy gauge steel.
- D. Rigid Construction: All parts such as blades and dampers shall be structurally rigid so as to operate uniformly over the entire length.
 1. Linear diffusers with components which twist, bend, warp or buckle shall be removed and replaced with new structurally sound units.
 2. Align butt edges using slotted key strips or other concealed means.
- E. Mounting Frames: Provide heavy duty mounting frame for floor installation (Titus Type 5).
- F. Concealed Hardware: Conceal all screws, bolts and mounting hardware.
- G. Joints: Provide standards alignment strips/wires for joining sections for continuous appearance.
- H. Provide aluminum finish.

2.5 WALL GRILLES

- A. Provide wall grilles of type, capacity, and with accessories and finishes as listed on grille schedule. The following requirements shall apply to nomenclature indicated on schedule:
 1. Grille Materials:
 - a. Steel Construction: Manufacturer's standard stamped sheet steel frame and adjustable blades.

- b. Aluminum Construction: Manufacturer's standard extruded aluminum frame and adjustable blades.
- 2. Grille Faces:
 - a. Horizontal Straight Blades: Horizontal blades, individually adjustable, at manufacturer's standard spacing.
 - b. Vertically Straight Blades: Vertical blades, individually adjustable, at manufacturer's standard spacing.
 - c. Horizontal 45 Degree Fixed Blades: Horizontal blades, fixed at 45 degrees, at manufacturer's standard spacing.
- 3. Grille Patterns:
 - a. Single Deflection: 1-set of blades in face.
 - b. Double Deflection: 2-sets of blades in face, rear set at 90 degrees to face set.
- 4. Grille Accessories:
 - a. Extractor: Curved blades mounted on adjustable frame to produce air-scooping action in duct at register or grille take-off.
 - b. Plaster Frame: Perimeter frame designed to act as plaster stop and register or grille anchor.
 - c. Operating Keys: Tools designed to fit through grille face and operate pattern adjustable.
- 5. Grille Finishes:
 - a. Aluminum Enamel: Air-dried aluminum enamel prime finish.
 - b. White Enamel: Semi-gloss white enamel prime finish.
 - c. Aluminum Anodize: Aluminum etched and anodized, covered with clear lacquer finish.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate ceiling air diffusers and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.3 SPARE PARTS

- A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 233713

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**SECTION 235733 – PACKAGED
ROOFTOP AIR CONDITIONING UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Package rooftop unit.
- B. Heat exchanger.
- C. Refrigeration components.
- D. Unit operating controls.
- E. Roof curb.
- F. Electrical power connections.
- G. Operation and maintenance service.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Controls and Instrumentation: Installation and wiring of thermostats and other control components.
- B. Equipment Wiring Systems: Electrical connection of equipment.

1.03 RELATED SECTIONS

- A. Section 230100 - Basic Mechanical Requirements.
- B. Section 230553 - Mechanical Identification.
- C. Section 239993 – Testing, Adjusting and Balancing.
- D. Section 230548 - Vibration Control.
- E. Section 230713 - Mechanical Insulation.
- F. Section 239000 – Building Automation System
- G. Division 26 – Electrical

1.04 REFERENCES

- A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. ARI 360 - Unitary Air-Conditioning Equipment.
- C. ANSI/ASHRAE/IESNA 90.1-1999 - Energy Standard for New Buildings Except

Low-Rise Residential Buildings.

1.05 SUBMITTALS

- A. Submit equipment drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections.
- B. Submit product data indicating rated capacities, weights, accessories, and electrical requirements.
- C. Submit manufacturer's installation instructions.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, start-up and operating instructions, installation instructions, and maintenance procedures.

1.07 HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.08 WARRANTY

- A. Provide a full parts warranty for one (1) year from start-up or eighteen (18) months from shipment, whichever occurs first.
- B. Provide five (5) year warranty for compressors including Parts.
- C. Provide five (5) year limited warranty for heat exchanger including Parts.

1.09 REGULATORY REQUIREMENTS

- A. Units shall be manufactured to conform and be provided with UL label.
- B. Gas-fired heating rooftop units shall conform to UL795 for construction of packaged air conditioner.

1.10 EXTRA MATERIALS

- A. Provide one (1) extra set of pre and final filters.
- B. Provide 1 extra set of belts.

PART 2 PRODUCTS

2.01 SUMMARY

- A. The contractor shall furnish and install gas-fired package rooftop heating and cooling units as shown and scheduled on the contract documents. The units shall be installed in accordance with the manufacturer's instructions and perform at the specified conditions as scheduled.
- B. MANUFACTURERS
 - 1. Trane
 - 2. Carrier
 - 3. York

2.02 GENERAL UNIT DESCRIPTION

- A. Units furnished and installed shall be DX Cooling and gas-fired heating packaged rooftops as scheduled on contract documents and these specifications. Cooling capacity ratings shall be based on ARI Standard 360 testing requirements. Units shall consist of insulated double wall weathertight casing with compressors, air cooled condenser coil, condenser fans, evaporator coil, gas-fired heating section filters, supply and / or exhaust motors with variable frequency drives, unit controls.
- B. Units shall have labels, decals, and / or tags to aid in the service of the unit and indicate caution areas.
- C. Units shall be single piece construction as manufactured at the factory. Units shall be constructed for installation on a roof curb providing full perimeter support under entire unit.
- D. Units shall be factory run tested to include the operations of all fans, compressors, heat exchangers and control sequence.

2.03 UNIT CASING

- A. Cabinet: Double-wall galvanized steel, phosphatized, and painted with an air-dry finish with polyurethane foam core between sheet metal panels. Cabinet surface shall be tested 500 hours in salt spray in compliance with ASTM B117. Structural members shall be heavy gauge with access doors and removable panels of heavy gauge. Cabinet top cover shall be one piece construction or where seams exists, it shall be double hemmed and gasket sealed.
- B. Unit to have fully gasketed hinged access panels.

2.04 ELECTRICAL POWER CONNECTIONS

- A. Factory-made penetrations shall be provided for connection of all electrical wiring. These wiring provisions shall be through the Unit. Field penetrations of the unit base pan shall not be acceptable.

2.05 AIR FILTERS

- A. Air Filters: Filters shall be accessible through hinged access panels. PreFilters shall be 2" Pleated media, MERV8. Final filters to be 4" pleated media MERV 11.

2.06 FANS – SUPPLY / EXHAUST

- A. Provide forward-curved fans mounted with fixed pitch sheave drive assembly. Complete fans assemblies shall be statically and dynamically balanced.
- B. Fan shaft shall be mounted on grease lubricated ball bearings.
- C. All motors shall be high efficiency type and shall be circuit breaker protected.
- D. Provide factory mounted and wired Variable Frequency Drive on supply fan where scheduled on the contract documents.
- E. Mount fan motors and fans on a common base assembly and isolated from unit with 2" spring isolators. Provide thrust restraint isolation on the fan housing / foam board to assure smooth fan startup transition and operation.

2.07 GAS FIRED HEATING SECTION

- A. Provide gas-fired heating section as completely assembled and factory-installed heating system integral to unit, UL approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Provide capability for threaded gas piping connection through side or bottom of unit.
- B. Heating section shall be factory fire-tested prior to shipment.
- C. Gas Burner: Forced-draft type burner with adjustable combustion air supply, gas valve, manual shut-off, direct spark or pilot ignition, and flame sensing monitoring electrode. Provide air proving switch to prevent burner operation when burner is open for maintenance or inspection.
- D. Gas Burner Safety Controls: Provide electronic flame safety controls for the proving of combustion air prior to ignition sequence with pre-purge cycle, continuous electronic flame supervision, and modulating heat gas valve operation heaters.
- E. Combustion Blower: Provide centrifugal type fan with built-in thermal overload protection on fan motor.
- F. Heat Exchanger: Provide factory pressure- and leak- tested tubular two pass heat exchanger of free- floating design manufactured of 16-gauge stainless steel primary surface and 18-gauge stainless steel secondary surface.

2.08 EVAPORATOR COIL

- A. Provide heavy duty aluminum fins mechanically bonded to internally enhanced, copper tubes.

- B. Provide a thermostatic expansion valve for each refrigeration circuit. Factory pressure and leak test coils at 300 psi.
- C. Provide pitched stainless steel drain pan to assure positive drainage of condensate from the unit casing.

2.09 CONDENSER SECTION

- A. Provide aluminum fins mechanically bonded to copper tubes. Factory pressurize and leak test to 450 psig.
- B. Provide integral subcooling circuit(s) to prevent premature refrigerant flashing and to insure maximum operating efficiency.
- C. Provide vertical discharge, direct drive fans with steel blades, and three phase motors. Fans shall be statically balanced. Motors shall be permanently lubricated, with built-in current and thermal overload protection in a weathertight casing.
- D. Units to have condenser coil hail guards. Wire mesh not acceptable.

2.10 REFRIGERATION SYSTEM

- A. Compressor: shall be industrial grade, energy efficient direct drive 3600 RPM maximum speed reciprocating or scroll type. The motor shall have a suction gas cooled hermetic design. Compressor shall have centrifugal oil pump with dirt separator, oil sight glass and oil charging valve.
 - 1. If semi-hermetic reciprocating industrial grade compressors are utilized, provide single piece crankshafts, connecting rods aluminum pistons, rings to prevent gas leakage, high strength non-flexing ring type suction and discharge valves, spring loaded heads, replaceable cylinder liners and sealing service immersed in oil. Provide removable discharge heads and hand hole covers and discharge service valves.
 - 2. Provide compressor with automatic capacity reduction equipment consisting of suction valve unloaders.
- B. Provide with thermostatic motor winding temperature control to protect against excessive motor temperatures resulting from over - / under-voltage or loss of charge. Provide high and low pressure cutouts and reset relay.
- C. Provide factory-installed compressor lockout thermostat to prevent compressor operation at low ambient conditions.
- D. Provide coil frost protection compressor unloading based on refrigerant circuit suction temperature to prevent coil frosting with minimum energy usage.

2.11 EXHAUST / RETURN SECTION

- A. Provide 100% modulating Power exhaust capabilities integral to the unit. Unit shall control building pressurization by the operation of exhaust fans and modulation of discharge dampers. Controller shall compare actual interior

building pressure with outside ambient pressure and supply air duct pressure. Setpoint shall be field adjustable through the human interface panel on the unit.

2.12 OUTDOOR AIR SECTION

- A. Provide a fully integrated factory installed 100% modulating outside air economizer with unit return and barometric relief / exhaust air dampers. Economizer operation shall be through microprocessor based primary temperature controls that automatically modulate dampers to maintain space temperature conditions.
 - 1. Provide economizer with Comparative Enthalpy control.
 - 2. Provide adjustable minimum position control located on economizer board.
 - 3. Provide spring return motor for outside air damper closure during unit shutdown or power interruption.

2.13 DAMPERS

- A. Provide low leakage type dampers. Leakage rates shall be based on one inch W.C. static pressure.
- B. Leakage rate shall be determined in accordance with AMCA Standard 575.

2.14 DDC MICROPROCESSOR CONTROLS

- A. General – Unit shall be provided with a factory-installed, programmed and run-tested, stand-alone, microprocessor control system suitable for single zone VAV control as required. This system shall consist of temperature and pressure (thermistor and transducer) sensors, printed circuit boards and a unit-mounted Human Interface Panel. The microprocessor shall be equipped with on-board diagnostics to indicate that all hardware, software and all interconnected wiring and sensors are in proper operating condition. The microprocessor's memory shall be non-volatile EEPROM type, thus requiring no battery or capacitive backup to maintain all data during a power loss.
- B. The Human Interface Panel shall be readily accessible for service diagnosis and programming without having to open the main control panel on the rooftop unit. Alphanumeric coded displays shall not be acceptable.
 - 1. Human Interface (HI) Panel – shall be a 16 key touch-sensitive membrane key switch panel, password protected to prevent use by unauthorized personnel. The Human Interface Panel display shall consist of a 2 line by 40 characters per line clear english display. The display shall be Supertwist Liquid Crystal Display (LCD) with blue characters, 5 x 7 dot matrix with cursor, on a grey-green background for high visibility and reading ease.
- C. Anti-recycle Protection – shall be provided to prevent excessive cycling, and premature wear of the compressors, contactors and relates components.
- D. Airflow modulation shall be provided by Variable frequency drive that is factory mounted, completely wired and functionally tested.
- E. Rooftop units shall have factory mounted and wired BAS (BACnet) interface

installed and shall be interfaced with an existing BAS in terminal building.

2.15 ROOF CURB

- A. Provide insulated roof curb, heavy gauge zinc coated steel with supply and return air gasketing. Curb shall provide insulation underneath outdoor section to prevent condensate formation. Ship knocked down and provide instructions for easy assembly.
- B. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that proper power supply is available.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork. Install roof mounting curb level.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s). Package rooftop unitary manufacturers shall maintain service capabilities no more than 100 miles from the jobsite.
- B. The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

END OF SECTION 235733

**NEW PARKING STRUCTURE AND
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**SECTION 237339 – INDOOR DIRECT FIRED
HEATING AND VENTILATION UNIT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes direct-fired H&V units.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories.
- 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. Prepare the following by or under the supervision of a qualified professional engineer:
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation hanger support rails and brackets.
 - 2. Vibration Isolation Hanger Support Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights. Also include the access platform detail as required for full service access to the unit per the manufacturer's requirements. Access platform shall be a minimum of 3'-0" wide along the length of the unit.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Gas Train Diagrams: Provide complete IRI gas train.
- C. Coordination Drawings: Mounting details drawn to scale for floor mounted unit, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Size and location of unit mounting rails and anchor points to concrete pad.
- D. Startup service reports.
- E. Operation and Maintenance Data: For direct-fired H&V units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of direct-fired H&V units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- 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 NFPA 70.
- D. ETL labeled
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- F. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.5 COORDINATION

- A. Coordinate size and location of unit supports and access doors.
- B. Coordinate size, location and installation of unit manufacturer's equipment supports with structure.
 - 1. Coordinate installation of vibration isolation for unit.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set(s) for each unit.
 - 2. Fan Belts: one set(s) for each unit.

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. Trane Company (basis of design).
 2. Titan Air Inc.
 3. Modine Mfg. Co.; Commercial HVAC&R Division.
 4. Reznor-Thomas & Betts Corporation; Mechanical Products Division.

2.2 PACKAGED UNITS

- A. Factory-assembled, horizontal, prewired, double wall, self-contained unit consisting of fully fiberglass insulated (2" thick) cabinet with motorized outside air damper set, integral fan and burner safeties and controls, filters, direct-fired gas furnace and supply fan to be installed inside the building. The unit shall be provided complete with IRI natural gas fuel train to include isolation plug valve and gas pressure regulator.

2.3 CABINET

- A. Cabinet: Double wall galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs.
- B. Access Panels: Lift-out for furnace and fan motor assemblies on both sides of unit.
- C. Internal Insulation: Fibrous-glass duct lining, comply with ASTM C 1071, Type II, applied on complete unit.
 1. Thickness: 2 inches (50 mm).
 2. Insulation Adhesive: Comply with ASTM C 916, Type I.
 3. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.
- D. Finish: Heat-resistant, baked enamel painted cabinet
- E. Discharge: Up-blast
- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

2.4 SUPPLY-AIR FAN

- A. Fan Type: Centrifugal, double width, double inlet, forward curved fan wheel, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft with heavy-duty, pillow-block bearings rated for L50 or 200,000 hours with external grease fittings.
- B. Motor: Totally enclosed, single-speed motor.

- C. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.
- D. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with spring isolators.

2.5 AIR FILTERS

- A. Comply with NFPA 90A.
- B. Disposable Panel Filters: 2-inch- (50-mm-) thick, factory-fabricated, flat-panel-type, disposable air filters with holding frames with a minimum efficiency report value of 6 according to ASHRAE 52.2 and 90 percent average arrestance according to ASHRAE 52.1.
 - 1. Media: Interlaced polyester fibers.
 - 2. Frame: Galvanized steel.

2.6 DAMPERS

- A. Outdoor-Air Damper: Galvanized-steel, opposed-blade dampers with vinyl blade seals and stainless-steel jamb seals, having a maximum leakage of 10 cfm/sq. ft. of damper area, at differential pressure of 2-inch wg (448 Pa).
- B. Damper Operator: Direct coupled, electronic with spring return or fully modulating as required by the control sequence.

2.7 DIRECT-FIRED GAS FURNACE

- A. Description: Factory assembled, piped, and wired; and complying with ANSI Z83.4, "Direct Gas-Fired Make-Up Air Heaters"; ANSI Z83.18, "Direct Gas-Fired Industrial Air Heaters"; and NFPA 54, "National Fuel Gas Code."
- B. Inside Unit External Housing: Steel cabinet with integral support inserts.
 - 1. External Casing and Cabinet Finish: Baked enamel over corrosion-resistant-treated surface in color to match fan section.
- C. Burners: Cast-iron burner with stainless-steel mixing plates.
 - 1. Control Valve: Modulating with minimum turndown ratio of 25:1
 - 2. Fuel: Natural gas.
 - 3. Pilot: Electrically ignited by hot-surface ceramic igniter.
- D. Safety Controls:
 - 1. Gas Manifold: Safety switches and controls to comply with ANSI standards and IRI gas train.

2. Purge-Period Timer: Automatically delays burner ignition and bypasses low-limit control.
3. Airflow Proving Switch: Dual pressure switch senses correct airflow before energizing pilot and requires airflow to be maintained within minimum and maximum pressure settings across burner.
4. Manual-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
5. Gas Train: Redundant, automatic main gas valves, electric pilot valve, electronic-modulating temperature control valve, main and pilot gas regulators, main and pilot manual shutoff valves, main and pilot pressure taps, and high-low gas pressure switches to comply with IRI requirements.
6. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.
7. Control Transformer: Integrally mounted 24-V ac.

2.8 CONTROLS

- A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.
- B. Control Panel: Recessed, with trim ring, remote panel, with engraved plastic cover, and the following lights and switches:
 1. On-off-auto switch
 2. Fused Disconnect switch
 3. Exhaust interlocks
 4. Interlocking relay
 5. Inlet ON-OFF duct stat
 6. Automatic changeover
 7. Supply-fan operation indicating light
 8. Heating operation indicating light
 9. Damper position potentiometer
 10. Seven-Day Time-clock/Night Setback Thermostat
 11. Dirty-filter indicating light operated by unit-mounted differential pressure switch
 12. Safety-lockout indicating lights
 13. Access door interlock switch, an alarm horn with silence switch, low temperature
 14. Room Override Thermostat w/ Discharge Air Temperature Controls
- C. BAS Interface: Factory installed BACnet based communication consisting of hardware and software shall enable the existing BAS to monitor, control and display status and alarms of heating and ventilating unit. The control features and monitoring points displayed locally at heating and ventilating unit control panel shall be available through the BAS.

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 installation of direct-fired H&V units.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."
- B. Install controls and equipment shipped by manufacturer for field installation with direct-fired H&V units.

3.3 CONNECTIONS

- A. Piping Connections: Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance.
 - 1. Gas Piping: Comply with requirements in Division 22 Section for natural gas piping. Connect gas piping with shutoff valve and union and with sufficient clearance for burner removal and service. Provide AGA-approved flexible connectors.
- B. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply ducts to direct-fired H&V units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Duct Accessories."
- C. Ground equipment according to Division 26 for Grounding and Bonding.
- D. Connect wiring according to Division 26 for Conductors and Cables.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Inspect for visible damage to furnace combustion chamber.
 - 2. Inspect casing insulation for integrity, moisture content, and adhesion.

3. Verify that clearances have been provided for servicing.
 4. Verify that controls are connected and operable.
 5. Verify that filters are installed.
 6. Purge gas line.
 7. Inspect and adjust vibration isolators.
 8. Verify bearing lubrication.
 9. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 10. Adjust fan belts to proper alignment and tension.
 11. Start unit according to manufacturer's written instructions.
 12. Complete startup sheets and attach copy with Contractor's startup report.
 13. Inspect and record performance of interlocks and protective devices; verify sequences.
 14. Operate unit for run-in period recommended by manufacturer.
 15. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
 - a. Measure gas pressure on manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
 16. Calibrate thermostats.
 17. Adjust and inspect high-temperature limits.
 18. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
 19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
 20. Measure and record airflow. Plot fan volumes on fan curve.
 21. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:
 - a. High-limit heat.
 - b. Alarms.
 22. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace malfunctioning components that do not pass tests and inspections and retest as specified above.
- D. Prepare written report of the results of startup services.
- 3.5 ADJUSTING
- A. Adjust initial temperature 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 direct-fired H&V units.

END OF SECTION 237339

**NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 238239 – ELECTRIC UNIT HEATERS
AND BASEBOARD HEATERS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. Extent of terminal unit work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of terminal units required for project include the following:
 - 1. Electric Unit Heaters
 - 2. Electric Baseboard Heaters
- C. Related Sections:
 - 1. Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS.
 - 2. Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of terminal units, of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.
- B. UL Compliance: Provide electrical components for terminal units which have been tested and labeled by UL.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications for terminal units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.
- B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, and field connection details.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

- D. Maintenance Data: Submit maintenance instructions, including lubrication instructions, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged terminal units or components; replace with new.
- B. Store terminal units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with Manufacturer's rigging and installation instructions for unloading terminal units, and moving them to final location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering equipment which may be incorporated in the work include, but are not limited to, the following:
- B. Manufacturer: Subject to compliance with requirements, provide one of the following:
 - 1. Unit Heaters:
 - a. Vulcan
 - b. Trane
 - c. Indeeco
 - 2. Baseboard Heaters:
 - a. Vulcan
 - b. Trane
 - c. Indeeco

2.2 UNIT HEATERS

- A. General: Provide unit heaters in locations as indicated, and of capacities, style, and having accessories as scheduled.
- B. Electric Horizontal Unit Heaters:
 - 1. Casings: Construct of steel, phosphatized inside and out, and finished with baked enamel. Provide motor-mounted panel, minimum of 18-gauge steel. Fabricate casing to enclose coil, louvers, and fan blades. Provide individual adjustable louvers to direct air.
 - 2. Fans: Construct of aluminum, and factory-balance. Provide fan inlet orifice, smooth, and drawn into casing back panel.

- C. Electric Vertical Unit Heaters:
 - 1. Casings: Construct of steel, phosphatized inside and out, and finished with baked enamel. Design casing to enclose fan, motor, and coil, design fan orifice formed into discharge panel. Provide air diffusers as scheduled.
 - 2. Fans: Construct of aluminum and factory-balance. Design so motor and fan assembly is removable through fan outlet panel.
- D. Coils: Industrial grade, type 304 stainless steel tubular elements.
- E. Motors: Provide totally enclosed motors, with built-in overload protection, having electrical characteristics as scheduled.
- F. Provide built-in transformer for low voltage controls.
- G. Provide wall mounted thermostat

2.3 BASEBOARD HEATERS

- A. General: Provide electric baseboard heaters in locations as indicated, and of capacities, style, and having accessories as scheduled.
- B. Two piece all aluminum, 14 gauge front and back with 4" junction boxes at each end with 3/4" EMT raceway.
- C. UL listed
- D. Full length thermal limit switch
- E. Bottom intake, top discharge
- F. Complete with end caps, walltrims, corner and blank off sections
- G. Built in thermostat and disconnect
- H. Color selected by Architect

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF UNIT HEATERS

- A. General: Install unit heaters as indicated, and in accordance with manufacturer's installation instructions.
- B. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.

- C. Hang units from building substrate, not from piping. Mount as high as possible to maintain greatest headroom possible unless otherwise indicated.
- D. Support units with rod-type hangers anchored to building substrate.
- E. Protect units with protective covers during balance of construction.

3.3 ELECTRICAL WIRING

- A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electric Installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.4 ADJUSTING AND CLEANING

- A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION 238239

**NEW PARKING STRUCTURE AND
EXTERIOR WAYFINDING SIGNAGE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 239000 – BUILDING
AUTOMATION SYSTEM**

**PART 1
GENERAL SCOPE:**

Provide stand-alone Direct Digital Control (DDC) system for (1) single zone VAV rooftop unit and (2) direct fired 100% outdoor air unit. This contractor shall install and wire requisite thermostats for respective equipment and provide low voltage control power wiring as required. The control of exhaust fans, electric baseboard heaters and unit heaters shall be incorporated. To monitor and control the garage building equipment from the existing terminal building, the control contractor shall provide a compatible and completely functional BACnet communication interface between garage building new equipment and an existing BAS located in airport terminal building. It is required of the contractor to visit the airport terminal building, and get familiarize with an existing BAS.

1.0 SECTION INCLUDES

- A. Products Furnished But Not Installed Under This Section.
- B. Products Installed But Not Furnished Under This Section.
- C. Products Not Furnished or Installed But Integrated with the Work of this Section.
- D. Related Sections.
- E. Description.
- F. Approved Control System Contractor.
- G. Quality Assurance.
- H. Codes and Standards.
- I. System Performance.
- J. Submittals.
- K. Warranty.
- L. Ownership of Proprietary Material.

1.1 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Division 23 - Ductwork Accessories:
 - 1. Automatic Dampers
 - 2. Airflow Stations
 - 3. Terminal Unit Controls

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Division 23 – Packaged Rooftop Unit and Make-Up Air Unit
 - 1. Thermostats.
 - 2. Sensors.
 - 3. Controllers.

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

- A. Division 23 – Rooftop Air Conditioning Equipment and Make-Up Air Units

1. Discharge Air Temperature Control.
2. Economizer Control.
3. Air volume control.

1.4 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Section as a part of the Contract Documents. Consult them for further instructions pertaining to this work.

1.5 DESCRIPTION

- A. General: The control system shall be as described in the specifications, and consist of a peer-to-peer network of digital building control panels and local operator interface(s).
- B. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of systems defined for control on this project.
- C. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited by operator password.
- D. The control system shall be designed such that each mechanical system will operate under stand-alone control. As such, in the event of a network communication failure, or the loss of other controllers, the control system shall continue to independently operate the unaffected equipment.
- E. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. A modem or network communications card shall be provided to for remote access to the system.

1.6 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS

- A. Approved Control System Contractors and Manufacturers:

| Manufacturer Name | Product Line | Contractor Name / Address | Contact |
|--------------------------|---------------------|----------------------------------|----------------|
| Trane | Tracer Summit | | |
| Andover | Continuum | | |
| Siemens | Apogee | | |

1. The above list of manufacturers applies to operator workstation software, controller software, the custom application programming language, Building Controllers, Custom Application Controllers, and Application Specific Controllers. All other products specified herein (i.e., sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

1.7 QUALITY ASSURANCE

A. System Installer Qualifications

1. The Installer shall have an established working relationship with the Control System Manufacturer of not less than three years.
2. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.
3. The installer shall have an office within 50 miles of the project site and provide 24-hour response in the event of a customer call.

1.8 CODES AND STANDARDS

A. Work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of local, state and federal authorities. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:

1. National Electric Code (NEC).
2. International Building Code (IBC).
3. International Mechanical Code (IMC).
4. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
5. ANSI/ASHRAE Standard 135-2004 (BACnet).
6. Optional ANSI/EIA/CEA-709.1 (LonTalk).

1.9 SYSTEM PERFORMANCE

A. Performance Standards. The system shall conform to the following:

1. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds.
2. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or operator display will be current, within the prior 60 seconds.
3. Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated on the BAS network shall not exceed 45 seconds.
4. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
5. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
6. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

Table 1
Reporting Accuracy

| Measured Variable | Reported Accuracy |
|-------------------------------|--------------------------|
| Space Temperature | ±0.5°C [±1°F] |
| Ducted Air | ±1.0°C [±2°F] |
| Outside Air | ±1.0°C [±2°F] |
| Delta-T | ±0.15°C [±0.25°F] |
| Relative Humidity | ±5% RH |
| Air Flow (measuring stations) | ±5% of reading |
| Air Pressure (ducts) | ±25 Pa [±0.1 "W.G.] |
| Air Pressure (space) | ±3 Pa [±0.01 "W.G.] |
| Electrical Power | ± 5% of reading *Note 1 |
| Carbon Monoxide (CO) | ± 5% of reading |
| Carbon Dioxide (CO2) | ± 50 PPM |

Note 1: * not including utility supplied meters

1.10 SUBMITTALS

- A. Contractor shall provide shop drawings and manufacturers' standard specification data sheets on all hardware and software to be provided. No work may begin on any segment of this project until the Engineer and Owner have reviewed submittals for conformity with the plan and specifications. Six (6) copies are required. All shop drawings shall be provided to the Owner electronically as .pdf, .dwg or .dxf file formats.
- B. Quantities of items submitted shall be reviewed by the Engineer and Owner. Such review shall not relieve the contractor from furnishing quantities required for completion.
- C. Provide the Engineer and Owner, any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.
- D. Submit the following within forty-five (45) days of contract award:
 1. A complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.
 2. A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
 3. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and / or drawing that the submittal is being submitted to cover. Include:
 - a) Building Controllers.
 - b) Custom Application Controllers.
 - c) Application Specific Controllers.
 - d) Auxiliary Control Devices.
 - e) Proposed control system riser diagram showing system configuration, device locations, addresses, and cabling.

- f) Detailed termination drawings showing all required field and factory terminations. Terminal numbers shall be clearly labeled.
 - g) Points list showing all system objects, and the proposed English language object names.
 - h) Sequence of operations for each system under control. This sequence shall be specific for the use of the Control System being provided for this project.
- E. Project Record Documents. Upon completion of installation submit three (3) copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and include:
- 1. Project Record Drawings. These shall be as-built versions of the submittal shop drawings. One set of electronic media including CAD .DWG or .DXF drawing files shall also be provided.
 - 2. Testing and Commissioning Reports and Checklists.
 - 3. Operating and Maintenance (O & M) Manual. These shall be as-built versions of the submittal product data. In addition to that required for the submittals, the O & M manual shall include:
 - a) Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.
 - b) Operators Manual with procedures of operating the control systems including logging on / off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.
 - c) Programming Manual with a description of the programming language including syntax, statement descriptions including algorithms and calculations used, point database creation and modification, program creation and modification, and use of the editor.
 - d) Engineering, Installation and Maintenance Manual(s) that explains how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.
 - e) A listing and documentation of all custom software created using the programming language including the point database. One set of magnetic media containing files of the software and database shall also be provided.
 - f) One set of electronic media containing files of all color-graphic screens created for the project.
 - g) Complete original issue documentation, installation, and maintenance information for all third party hardware provided including computer equipment and sensors.
 - h) Complete original issue media for all software provided including operating systems, programming language, operator workstation software, and graphics software.
 - i) Licenses and warranty documents for all equipment and systems.
 - j) Recommended preventive maintenance procedures for all system components including a schedule of tasks, time between tasks, and task descriptions.

- F. Training Materials: The Contractor shall provide a course outline and training material for all training classes at least six (6) weeks prior to the first class. The Owner reserves the right to modify any or all of the training course outline and training materials. Review and approval by Owner and Engineer shall be completed at least three (3) weeks prior to first class.

1.11 WARRANTY

- A. Warrant all work as follows:
 1. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within twenty-four (24) hours during customary business hours.
 2. At the end of the final start-up / testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.
 3. Project specific software, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.

1.12 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All project-developed hardware and software shall become the property of the Owner. These items include but are not limited to:
 1. Project graphic images.
 2. Record drawings.
 3. Project database.
 4. Project-specific application programming code.
 5. All documentation.

PART 2 PRODUCTS

2.0 SECTION INCLUDES

- A. Materials
- B. Communication
- C. Operator Interface
- D. Application and Control Software
- E. Building Controllers
- F. Custom Application Controllers
- G. Application Specific Controllers
- H. Input / Output Interface
- I. Auxiliary Control Devices

2.1 MATERIALS

- A. All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of two (2) years. The installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing. Spare parts shall be available for at least five (5) years after completion of this contract.

2.2 COMMUNICATION

- A. This project shall comprise of a network utilizing high-speed BACnet for communications between Building Controllers. LonTalk sub-networks shall be used for communications between Building Controllers, Custom Application Controllers and Application Specific Controllers.
- B. The controls Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the DDC system internetwork.
- C. All Building Controllers shall have a communications port for connections with the operator interfaces. This may be either a network interface node for connection to the Ethernet network or an RS-232 port for Point to Point connection.
- D. Remote operator interface via a 56K baud modem shall allow for communication with any and all controllers on this network as described in the following paragraph.
- E. Communications services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
 - 1. Connection of an operator interface device to any one building controller on the internetwork will allow the operator to interface with all other building controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all building controllers shall be available for viewing and editing from any one building controller on the internetwork.
 - 2. All database values (i.e., points, software variable, custom program variables) of any one building controller shall be readable by any other building controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform internetwork value passing.
- F. The time clocks in all controllers shall be automatically synchronized daily.

2.3 APPLICATION AND CONTROL SOFTWARE

- A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

- B. System Security
1. User access shall be secured using individual security passwords and user names.
 2. Passwords shall restrict the user to only the objects, applications, and system functions as assigned by the system manager.
 3. User logon / logoff attempts shall be recorded.
 4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
- C. Scheduling. Provide the capability to schedule each object or group of objects in the system. Each of these schedules shall include the capability for start, stop, optimal start, optimal stop, and night economizer actions. Each schedule may consist of up to ten (10) events. When a group of objects are scheduled together, provide the capability to define advances and delays for each member. Each schedule shall consist of the following:
1. Weekly Schedule. Provide separate schedules for each day of the week.
 2. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. This exception schedule shall override the standard schedule for that day. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed it will be discarded and replaced by the standard schedule for that day of the week.
 3. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
 4. Optimal Start. The scheduling application outlined above shall support an optimal start algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. The algorithm shall calculate separate sets of heating and cooling rates for zones that have been unoccupied for less than and greater than twenty-four (24) hours. Provide the ability to modify the start algorithm based on outdoor air temperature. Provide an early start limit in minutes to prevent the system from starting before an operator determined time limit.
- D. Remote Communications. The system shall have the ability to transmit alarms to multiple associated alarm receivers. Receivers shall include PC Workstations, email addresses, cell phones and alphanumeric pagers. The alarm message shall include the name of the alarm location, the device that generated the alarm, and the alarm message itself. The operator shall be able to remotely access and operate the system utilizing the system Ethernet communications, or dial up communications via modem, in the same format and method used on an existing Operator Interface.
- E. Maintenance Management. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts, and / or calendar date limits.
- F. PID Control. A PID (proportional-integral-derivative) algorithm with direct or reverse action and anti-wind-up shall be supplied. The algorithm shall calculate a

time-varying analog value used to position an output or stage a series of outputs. The controlled variable, set-point, and PID gains shall be user-selectable. The set-point shall optionally be chosen to be a reset schedule.

- G. Timed Override. A standard application shall be utilized to enable/disable temperature control when a user selects on/cancel at the zone sensor, workstation, or the operator display. The amount of time that the override takes precedence will be selectable from the workstation.
- H. Staggered Start. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started; along with the time delay between starts shall be user-selectable.
- I. Anti-Short Cycling. All binary output points shall be protected from short cycling. This feature shall allow minimum on-time and off-time to be selected.

2.4 BUILDING CONTROLLERS

- A. General. Provide Building Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
 - 1. The Building Automation System shall be composed of one or more independent, standalone; microprocessor based Building Controllers to manage the global strategies described in System software section.
 - 2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 3. The controller shall provide a communications port for connection of the Portable Operators Terminal.
 - 4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - 5. Controllers that perform scheduling shall have a real time clock.
 - 6. Data shall be shared between networked Building Controllers.
 - 7. The Building Controller shall utilize industry recognized open standard protocols for communication to unit controllers.
 - 8. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a) Assume a predetermined failure mode.
 - b) Generate an alarm notification.
 - c) Create a retrievable file of the state of all applicable memory locations at the time of the failure.
 - d) Automatically reset the Building Controller to return to a normal operating mode.
- B. Communications. Each Building Controller shall reside on a BACnet internetwork using the ISO 8802-3 (Ethernet) Physical / Data Link layer protocol. Each Building Controller shall also perform routing to a network of Custom Application and Application Specific Controllers. Each Building Controller shall perform communications to a network of Custom Application and Application Specific Controllers using LonTalk FTT-10 and LonMark profiles.

- C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller used in conditioned ambient shall be mounted in an enclosure, and shall be rated for operation at 32 F to 120 F.
- D. Serviceability. Provide diagnostic LEDs for power, communications, and processor. The Building Controller shall have a display on the main board that indicates the current operating mode of the controller. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable. The primary logic board shall be removable without disconnecting field wiring.
- E. Memory. The Building Controller shall maintain all BIOS and programming information in the event of a power loss for at least seventy-two (72) hours.
- F. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage
- G. Building Controller Operator Display. Each building controller shall include an operator display allowing the user to perform basic daily operations tasks on the building automation system. At a minimum this operator display shall:
 - 1. Be installed on the building controller and require no additional power source.
 - 2. Consist of a one-quarter VGA touch screen with 320 X 240-pixel resolution. The brightness and the contrast of the backlit touch screen shall be adjustable to allow for easy reading of information on the screen.
 - 3. Be capable of having unique user identification and passwords that can be programmed to limit access to the system and operator functions.
 - 4. Display the current state of an input / output point and equipment controller connected to the system.
 - 5. Give the operator the ability to override the current state of an output point or HVAC equipment controller connected to the building controller.
 - 6. Allow the operator to modify the start and stop times of any time-of-day schedule within the system.
 - 7. Provide a visual indication that a system alarm exists and allow for an optional audible alarm annunciation.
 - 8. Provide the ability to view and acknowledge alarms that are annunciated at that building controller.
 - 9. Allow the operator to view custom graphical displays with dynamic status information.
 - 10. Automatically update displayed system information every ten (10) seconds.

2.5 CUSTOM APPLICATION CONTROLLERS

- A. General. Provide Custom Application Controllers to provide the performance specified in section 1 of this division. Each of these panels shall meet the following requirements.
 - 1. The Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 2. Controllers that perform scheduling shall have a real time clock.

3. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
4. The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode, and generate an alarm notification.

2.6 APPLICATION SPECIFIC CONTROLLERS

- A. General. Application specific controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
 1. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.
 2. Each ASC will contain sufficient I/O capacity to control the target system.

2.7 INPUT / OUTPUT INTERFACE

- A. Hard-wired inputs and outputs may tie into the system through Building, Custom, or Application Specific Controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of on / off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices.
- D. Pulse accumulation input points. This type of point shall conform to all the requirements of Binary Input points, and also accept up to 3 pulses per second for pulse accumulation, and shall be protected against effects of contact bounce and noise.
- E. Analog inputs shall allow the monitoring of low voltage (0-10 Vdc), current (4-20 ma), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.
- F. Binary outputs shall provide for on / off operation. Terminal unit and zone control applications may use 2 outputs for drive-open, drive-close (tri-state) modulating control.
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device.

2.8 AUXILIARY CONTROL DEVICES

- A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:
 - 1. Damper frames shall be 16 gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
 - 2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
 - 3. Damper shaft bearings shall be as recommended by manufacturer for application.
 - 4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
 - 5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
 - 6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.
- B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.
- C. Electric damper / valve actuators.
 - 1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
 - 2. Where shown, for power-failure / safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
 - 3. All rotary spring return actuators shall be capable of both clockwise or counter clockwise spring return operation. Linear actuators shall spring return to the retracted position.
 - 4. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.
 - 5. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.
 - 6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
 - 7. Actuators shall be Underwriters Laboratories Standard 873 listed.
 - 8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.
- D. Binary Temperature Devices
 - 1. Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
 - 2. Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-

state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.

3. Low-Limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

E. Temperature Sensors

1. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.
2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5m [5 feet] in length.
3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
4. Space sensors shall be equipped with set-point adjustment, override switch, display, and / or communication port as shown on the drawings.
5. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C [0.2 F].

G. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of $\pm 5\%$ R.H.
2. Duct sensors shall be provided with a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40 C to 75 C [-40 F to 170 F].
4. Humidity sensor's drift shall not exceed 1% of full scale per year.

H. Static Pressure Sensors

1. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
2. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
3. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
4. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

I. Low Limit Thermostats

1. Safety low limit thermostats shall be vapor pressure type with an element 6m [20 ft] minimum length. Element shall respond to the lowest temperature sensed by any one foot section.
2. Low limit shall be manual reset only.

- J. Carbon Dioxide (CO₂) Sensors
 - 1. Carbon Dioxide sensors shall measure CO₂ in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated in the sequence of operation.
- K. Flow Switches
 - 1. Flow-proving switches shall be differential pressure.
 - 2. Differential pressure type switches shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 Type enclosure, with scale range and differential suitable for intended application, or as specified.
 - 3. Current sensing relays may be used for flow sensing or terminal devices.
- J. Relays
 - 1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
 - 2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.
- K. Transformers and Power Supplies
 - 1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
 - 2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
 - 3. Unit shall be UL recognized.
- L. Current Switches
 - 1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.
- M. LOCAL CONTROL PANELS
 - 1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
 - 2. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and / or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control / interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified.
 - 3. Provide on / off power switch with over-current protection for control power sources to each local panel.

PART 3 EXECUTION

3.0 SECTION INCLUDES:

- A. Examination.
- B. Protection.
- C. General Workmanship.
- D. Field Quality Control.
- E. Wiring.
- F. Installation of Sensors.
- G. Flow Switch Installation.
- H. Actuators.
- I. Identification of Wiring.
- J. Controllers.
- K. Programming.
- L. Cleaning.
- M. Training.
- N. Acceptance.

3.1 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations, and any discrepancies, conflicts, or omissions shall be reported to the Architect / Engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment is installable as shown, and any discrepancies, conflicts, or omissions shall be reported to the Architect / Engineer for resolution before rough-in work is started.

3.2 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 GENERAL WORKMANSHIP

- A. Install equipment, piping, wiring / conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

- C. Install all equipment in readily accessible location as defined by chapter 1 article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.4 FIELD QUALITY CONTROL

- A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.
- B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.
- C. Contractor shall arrange for field inspections by local and / or state authorities having jurisdiction over the work.

3.5 WIRING

- A. All control and interlock wiring shall comply with the national and local electrical codes and Division 26 of these specifications. Where the requirements of this section differ with those in Division 26, the requirements of this section shall take precedence.
- B. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:
- C. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
- D. All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose.
- E. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- F. Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.

- G. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- H. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.
- I. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.
- J. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.
- K. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.
- L. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.
- M. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.
- N. Adhere to Division 26 requirements for installation of raceway.
- O. This Contractor shall terminate all control and / or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

3.6 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Install duct static pressure tap with tube end facing directly down-stream of air flow.

- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.7 ACTUATORS

- A. Mount and link control damper actuators per manufacturer's instructions.
 - 1. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
 - 2. Check operation of damper / actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 3. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.8 IDENTIFICATION OF WIRING

- A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information.
- B. Permanently label or code each point of field terminal strips to show the instrument or item served.

3.9 CONTROLLERS

- A. Provide a separate Controller for each major piece of HVAC equipment. A custom application controller may control more than one system provided that all points associated with that system are assigned to the same controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.
- B. Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.
 - 1. Future use of spare capacity shall require providing the field device, field wiring, points database definition, and custom software. No additional

Controller boards or point modules shall be required to implement use of these spare points.

3.10 PROGRAMMING

- A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory free for future use.
- B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming
 - 1. Provide programming for the system as written in the specifications and adhere to the sequence strategies provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into any custom-written control programs sufficient comment statements or inherent flow diagrams to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.
- D. Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of eight (8) hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

3.11 CLEANING

- A. This contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.
- B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.
- C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.12 TRAINING

- A. Provide a minimum of two (2) on-site training sessions, four (4) hours each, throughout the contract period for personnel designated by the Owner.

- B. Train the designated staff of Owner's representative and Owner to enable them to proficiently operate the system; create, modify and delete programming; add, remove and modify physical points for the system, and perform routine diagnostic and troubleshooting procedures.
- C. Additional training shall be available in courses designed to meet objectives as divided into three logical groupings; participants may attend one or more of these, depending on the level of knowledge required:
 - 1. Day-to-day Operators
 - 2. Advanced Operators
 - 3. System Managers / Administrators
- D. Provide course outline and materials as per Part 1 of this Section. The instructor(s) shall provide one copy of training material per student.
- E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.
- F. This training shall be made available in addition to the interactive audio-visual tutorial, provided with the system.

3.13 ACCEPTANCE

- A. The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

PART 4 SEQUENCE OF OPERATION

4.01 Single Zone Variable Air Volume (SZ VAV) Rooftop Unit Control – RTU-1

- A. For normal Cooling operation, available cooling capacity will be staged or modulated in order to meet the calculated discharge air setpoint between the user selected upper and lower limits. If the current active cooling capacity is controlling the discharge air within the deadband no additional Cooling capacity change will be requested. As the discharge air temperature rises above the deadband the control will request additional capacity as required (additional compressor operation or economizer). As the discharge air temperature falls below the deadband the algorithm will request a reduction in active capacity.
- B. Cooling Operation: If the control determines that there is a need for compressor stages in order to meet the discharge air requirements, once supply fan proving has been made, the unit will begin to stage compressors. As the zone cooling demand continues to increase, if additional capacity is required, the supply fan output will be modulated above minimum speed in order to meet the zone requirements. As the cooling load in the zone decreases the control will reduce the speed of the fan down to minimum per compressor stage and control the compressor output accordingly. As the compressors begin to de-energize, the

supply fan speed will fall back to the cooling stage's associated minimum fan speed but not below. As the load in the zone continues to drop, cooling capacity will be reduced in order to maintain the calculated discharge air setpoint.

- C. Economizer Cooling: During normal economizer cooling, the fan speed will operate at its minimum. However, if the economizer is able to meet the demand alone, due to desirable ambient conditions, the supply fan speed will be allowed to increase above the minimum prior to utilizing mechanical cooling.
- D. Demand Controlled Ventilation: Units configured for SZ VAV and Demand Controlled Ventilation will invoke the new DMV scheme which allows variable Bldg. Design and DCV minimum positions and OA damper position target setpoints based on the supply fan speed and space CO2 required levels.
- E. Heating Operation: Heating operation of SZ VAV modulating gas heat units will have the ability to control the discharge air temperature to the calculated discharge air heating setpoint in order to maintain the zone temperature to the zone heating setpoint. When the unit control determines that there is a space heating demand, the unit will transition into zone heating. Once the discharge air temperature falls below the calculated discharge air temperature setpoint, the unit will initiate the modulating heat output request and control the supply fan at minimum speed. At this point, the modulating heat output will be controlled to maintain the discharge air temperature requirements and supply fan speed will be controlled between 63%-100% to meet the zone heating requirements. As the heating load in the zone decreases the fan speed decrease down to minimum and control the modulating heat output as necessary to meet the discharge air heating requirements. As the load in the zone continues to drop the fan speed will be maintained at the minimum airflow and the modulating heat output will be controlled accordingly.

4.02 Direct Gas-Fired Make-Up Air Unit (MAU-1)

- A. The Modulating Discharge Temperature (MDT) control system shall consist of the unit DDC Controller with full BACnet compatibility, a signal conditioner, a modulator/regulator gas valve, an inlet air sensor, and a remote control panel.
- B. A seven-day programmable thermostat shall start/stop the make air unit and associated interlocked exhaust fan(s) automatically. The outdoor air damper shall open when supply fan starts and close when fan stops. The tempering of makeup air shall be accomplished with a modulating discharge air temperature controller. Gas flow to the burner will be modulated to achieve the selected discharge air temperature setpoint.
- C. When the room temperature falls below the setpoint of the room thermostat, the discharge air temperature controller setpoint is automatically increased.
- D. Smoke detectors, located at supply air, shall stop fan when the presence of smoke is detected.
- E. On space CO detectors' high concentration alarm, the makeup unit and associated exhaust fans start if not running.

4.3 ELECTRIC UNIT HEATERS:

- A. Unit heaters shall be controlled with a wall mounted electric low voltage thermostats with built-in fan "ON / AUTO" switch.
- B. Unit heater shall be cycled by the thermostat to maintain space temperature setpoints.

4.4 EXHAUST FAN CONTROL:

- A. EF-1 & EF-2: Interlock exhaust fans with associated motorized outdoor air intake damper. The outdoor air damper shall open when supply fans start and close when fans stop.
- B. EF-3 & EF-4: Interlock exhaust fans with outdoor make-up air unit. When make-up air unit starts; the exhaust fans start, and when make-up air unit stops; the exhaust fans stops.
- C. EF-5: The exhaust fan shall be controlled thermostatically. On a rise in space temperature above setpoint; the fan shall start, when space temperature is satisfied; the fan shall stop.

END OF SECTION 239000

[illegible]

**DULUTH PARKING STRUCTURE
DULUTH INTERNATIONAL AIRPORT
DULUTH, MINNESOTA**

**SECTION 239993 – TESTING,
ADJUSTING AND BALANCING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. This section specifies the requirements and procedures total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
- B. Related Sections:
 - 1. General requirements for testing agencies are specified in the Division 1, QUALITY CONTROL.
 - 2. Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS
 - 3. Division 23, Section 230200 - BASIC MECHANICAL MATERIALS AND METHODS
 - 4. Division 23, Section 235733 – PACKAGED ROOFTOP AIR CONDITIONING UNITS
 - 5. Division 23, Section 233423 - POWER VENTILATORS
 - 6. Division 23, Section 233113 - METAL DUCTWORK
 - 7. Division 23, Section 233713 – DIFFUSERS, REGISTERS AND GRILLES
 - 8. Division 23, Section 237339 – Indoor Direct Fired H & V Unit
- C. Test, adjust, and balance the following mechanical systems:
 - 1. Supply air systems, all pressure ranges; including variable volume systems.
 - 2. Return air systems.
 - 3. Exhaust air systems.
 - 4. Verify temperature control system operation.
- D. Test systems for proper sound and vibration levels.
- E. This section does not include:
 - 1. Specifications for materials for patching mechanical systems;
 - 2. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.
 - 3. Requirements and procedures for ductwork systems leakage tests.

1.3 DEFINITIONS

- A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:
 - 1. The balance of air distribution;
 - 2. Adjustment of total system to provide design quantities;
 - 3. Electrical measurement;
 - 4. Verification of performance of all equipment and automatic controls;
 - 5. Sound and vibration measurement.
- B. Test: To determine quantitative performance of equipment.
- C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).
- D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
- E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
- F. Report forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.
- G. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply outlets on air terminals, and exhaust or return inlets on air terminals such as grilles, diffusers, louvers, and hoods.
- H. Main: Duct containing the system's major or entire fluid flow.
- I. Submain: Duct containing part of the systems' capacity and serving two or more branch mains.
- J. Branch main: Duct serving two or more terminals.
- K. Branch: Duct serving a single terminal.

1.4 SUBMITTALS

- A. Agency Data:
 - 1. Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Engineer and Technicians Data:
 - 1. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.

- D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 1 and Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS.
1. Provide written warranty similar to AABC National Performance Guarantee.

OPTION 1

- E. Sample Forms: Submit sample forms, if other than those standard forms prepared by the AABC or NEBB are proposed.

OPTION 2

- F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
1. Draft reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
 2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.
 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
 - a. General Information and Summary.
 - b. Air Systems.
 - c. Temperature Control Systems.
 - d. Special Systems.
 - e. Sound and Vibration Systems.
 4. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC and NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form. Include pump and fan curves plotted to actual operating point for each fan.
- G. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.5 QUALITY ASSURANCE

- A. Test and Balance Engineer's Qualifications: A Professional Engineer (either on the installer's staff or an independent consultant), registered in the State in which the services are to be performed, and having at least three (3) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Agency Qualifications:
 - 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
 - 2. An independent testing, adjusting, and balancing agency certified by the National Environmental Balancing Bureau (NEBB) or the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.
- C. Codes and Standards:
 - 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 - 2. AABC: "National Standards for Total System Balance".
 - 3. ASHRAE: ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.
- D. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the Architect and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

1.6 PROJECT CONDITIONS

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.7 SEQUENCING AND SCHEDULING

- A. Test, adjust, and balance the air systems before refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 degrees F wet bulb temperature of maximum summer design condition, and within 10 degrees F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

1.8 WARRANTY

- A. Provide extended warranty of 90 days, after completion of test and balance work, during which time Owner may at his discretion, request recheck or resetting or equipment or system which is not performing satisfactorily. Provide technicians to assist as required in making such tests.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

- A. Before operating the system, perform these steps:
 1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
 2. Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.
 3. Compare design to installed equipment and field installations.
 4. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.
 5. Check filters for cleanliness.
 6. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
 7. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
 8. Determine best locations in main and branch ductwork for most accurate duct traverses.
 9. Place outlet dampers in the full open position.
 10. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.
 11. Lubricate all motors and bearings.
 12. Check fan belt tension.
 13. Check fan rotation.

3.2 MEASUREMENTS

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
- B. Provide instruments meeting the specifications of the referenced standards.
- C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
- G. Take all reading with the eye at the level of the indicated value to prevent parallax.
- H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- I. Take measurements in the system where best suited to the task.

3.3 PERFORMING TESTING, ADJUSTING, AND BALANCING

- A. Perform testing and balancing procedures on each system identified, as listed below and in accordance with the detailed procedures outlined in the referenced standards.
- B. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- C. Patch insulation, ductwork, and housings, using materials identical to those removed.
- D. Seal ducts and test for and repair leaks.
- E. Seal insulation to re-establish integrity of the vapor barrier.
- F. Mark equipment settings, including damper control positions, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.4 AIR BALANCING METHODS

- A. Balance each air system that is served by air filters, using artificial static loading of system, to demonstrate, test and obtain system design pressure drop data.
 - 1. Provide dirty filter pressure drop conditions on system.
 - 2. Do not use high-efficiency filters (65 percent and above) in testing and balancing.
 - 3. Static pressure losses may be simulated by using wood or sheet steel blanking plates in high-efficiency filter racks and housings.
 - 4. Do not install blanking plates within 2 feet of low-efficiency filter unit or rack.

3.5 AIR BALANCE TESTING PROCEDURE

- A. Test and adjust equipment capacity to design requirements and record RPM.
- B. Test motor load amperes and fan rotations.
- C. Make pitot tube traverse of main supply ducts and obtain design CFM at fans. Provide fan curves and plots.
- D. Test system static pressures, suction and discharge.
- E. Test and adjust system for design CFM outside and return air:
 - 1. Maximum outside air setting.
 - 2. Minimum outside air setting.
- F. Test and adjust system for design CFM outside air.
- G. Test coil entering air temperatures:
 - 1. Dry bulb degrees F heating and cooling.
 - 2. Wet bulb degrees F cooling.
- H. Test leaving air temperatures:
 - 1. Dry bulb degrees F heating and cooling.
 - 2. Wet bulb degrees F cooling.
- I. Adjust main supply and return air ducts to proper design CFM.
- J. Adjust zones to proper design CFM, supply and return.
- K. Test and adjust each diffuser and grille to within 10 percent of design requirements.
 - 1. Identify location and area of each grille and diffuser.
 - 2. Identify and list size, type and manufacture of diffusers and grilles.
 - 3. Use manufacturer's ratings on equipment to make required calculations.
 - 4. Readings and tests of diffusers and grilles shall include required FPM velocity and test resultant velocity, required CFM and test resultant CFM after adjustments.
 - 5. Adjust diffusers and grilles to minimize drafts.

- L. In cooperation with control manufacturer's representative, set automatically operated dampers to operate as indicated.
 - 1. Check controls for proper calibration and list controls requiring adjustment by control installers.
- M. Balance supply, return and exhaust air to provide designed pressure relationships to adjacent areas.
- N. Make changes in pulleys, belts and dampers to achieve capacity.
- O. Check fire dampers and smoke dampers for correct operation and damper position.
- P. Adjust special equipment fans to CFM requirements as indicated.
- Q. List mechanical nameplate and specification of fans.
- R. Test hoods to determine velocities across openings and balance to design requirements.
 - 1. Hood Type: Fume, range and miscellaneous.

3.6 TESTING FOR SOUND AND VIBRATION

- A. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards.

3.7 RECORD AND REPORT DATA

- A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.
- B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

3.8 OPERATING TEST

- A. After systems are balanced, conduct operating test of not less than eight (8) hours duration each for heating and cooling systems to demonstrate to satisfaction of Owner that systems comply with requirements of plans and specifications and that equipment and controls are functioning properly.

3.9 DEMONSTRATION

- A. Training:
 - 1. Train the Owner's maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Review with the Owner's personnel, the information contained in the Operating and Maintenance Data specified in Division 1 and Division 23, Section 230100 - BASIC MECHANICAL REQUIREMENTS.
 - 2. Schedule training with Owner through the Architect with at least seven (7) days prior notice.

END OF SECTION 239993

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**SECTION 26.01.20 – INSTRUCTION
AND MAINTENANCE
MANUALS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide Instruction and Maintenance Manuals for each item of electrical equipment and product specified in Division 16 and shown on drawings, complete as specified herein.
- B. Submit three (3) copies of Instruction and Maintenance Manuals unless otherwise indicated or specified.

PART 2 - PRODUCTS

2.1 INSTRUCTION AND MAINTENANCE MANUALS

- A. Hardback three ring loose-leaf binder with reinforced holes in sheets and drawings neatly folded and not extending beyond the edge of the binder.
- B. Title sheet with job name, and the names, addresses and phone numbers of the Contractor, all Subcontractors and suppliers.
- C. Index of contents.
- D. A signed copy of acknowledgement of instruction to the Owner or the Owner's authorized representative for all electrical and control systems provided.
- E. Typewritten operating instructions for the Owner's personnel describing how to operate and maintain each piece of equipment. Where manufacturer's product is used, it shall be edited to exclude items not pertinent to this project.
- F. Approved shop drawings, submittal data and parts and maintenance booklet for each item of material and equipment furnished under Division 16. Final drawings shall include all dimensions.
- G. Record drawings of electrical and control diagrams.
- H. Copies of final inspection certificates.
- I. Guarantees and warranties including extended guarantees and warranties.
- J. Binders shall not be more than 3/4 full.

PART 3 - EXECUTION

3.1 AVAILABILITY

- A. Approved manuals shall be turned over to Owner's representative at the final inspection.
- B. A draft copy of type-written instructions shall be available during any required Owner-instruction period.

END OF SECTION 26.01.20

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**SECTION 26.05.01 – ELECTRICAL
WORK, GENERAL**

PART 1 - GENERAL

1.1 SUMMARY

- A. Divisions 26, 27, 28, 33, and 48 of the specifications covers all electrical work for the project. Work shall include labor, including time necessary to investigate existing conditions, material, tools, temporary wiring, accessories, etc. required to accomplish the work as specified and shown on the drawings.

1.2 CODES, PERMITS AND INSPECTIONS

- A. Installation shall comply with all laws applying to electrical installation in effect; with the regulations of the NEC, National Electrical Safety Code, and other applicable publications of the National Fire Protection Association, all local governing codes and ordinances and with the regulations of the serving utility company. Provide required permits.

1.3 SUBMITTALS

- A. Shop Drawings and Product Data:
 - 1. Shop Drawings: Shall be submitted on equipment as indicated under each section of this division. Shop drawings shall include sufficient information to indicate complete compliance with specifications.
 - 2. Product Data: Submittal shall include illustrations, catalog sheets, installation instructions, drawings, and certifications as required. Each sheet shall show manufacturer's name or trademark. Edit product data to identify only those items to be provided for this project.
 - 3. All equipment of a particular kind such as wiring devices, power distribution panelboards and switchboards, and all lighting fixtures of the same type, shall be the product of the same manufacturer.
 - 4. Where items are those specified, only a list of such items shall be provided, except where shop drawings and product data are specifically required.
 - 5. At the time of each submission, any deviations from the Contract Documents shall be called to the attention of the Architect-Engineer in writing, and be plainly marked on the shop drawings and product data.
- B. Record Drawings:
 - 1. Provide 1 complete set of contract drawings in clean, undamaged condition, indicating all significant changes from the work as shown. Use multiple pencil colors to aid in the differentiation of the work for separate electrical systems. In general, record every substantive detail of the electrical work which previously is either not shown or has been field modified.
 - a. Show exact locations of underground cable and conduits including manholes and handholes, both interior and exterior, drawn to scale and fully dimensioned from building column lines.

- b. Indicate mains and branches of wiring systems, with switchgear, panelboards, and control devices located and identified. Locate devices requiring maintenance.
 - c. Indicate changes in equipment ratings and locations.
 - d. Indicate scope of each change order and clarification, noting change order or clarification number.
- 2. Refer to General Conditions and Division 1 for additional requirements pertaining to record documents.
- C. Submit the following upon completion of the work:
 - 1. Certificate of Final Inspection from local authority.
 - 2. Tabulation of all motors listing respective manufacturer, horsepower, nameplate voltage and current, actual running current after installation and overload heater rating.
 - 3. O&M Manuals.

1.4 QUALITY ASSURANCE

- A. Materials shall comply with standards of UL, where standards have been established for the particular product and the various NEMA, ANSI, ASTM, IEEE, AEIC, ICEA or other publications referenced.

1.5 ELECTRIC SERVICE

- A. Electrical service shall be as shown on the drawings. The Contractor shall coordinate exact location, routing and other requirements with the local electric utility.
- B. Prior to beginning installation of any primary conduits, or transformer pad, Contractor shall contact and meet with the proper utility engineers to review the plans and project schedule.
- C. Electric energy for the project will be provided by electric utility using one utility furnished and installed pad-mounted transformer.
- D. The service voltage at the secondary side of the transformer shall be 480Y/277 volts three-phase, four-wire. The Contractor shall provide all elements of the system on the load side of the transformer as necessary to ensure a properly working system.
- E. The building service grounding electrode system shall comply with utility's regulations, local City codes and rules and the National Electrical Code requirements.
- F. Provide buried utility tape approximately 12 inches below grade along route of all utility primary conduits.

1.6 MANUFACTURERS' NAMES AND CATALOG NUMBERS

- A. In some instances, specific references have been made to one or more manufacturer's names and model or catalog numbers. Use of names and catalog numbers does not indicate that the equipment specified is necessarily an "off the

shelf" item. Variances may be due to requirement of a desired finish, material, or other modification.

- B. In the case of panelboards, safety switches and other equipment requiring wire and cable terminations, verify that lug sizes and wiring gutters or space allowed for proper accommodation and termination of the wire and cables are adequate.

1.7 PROTECTION OF ELECTRICAL EQUIPMENT

- A. Electrical equipment shall be protected from the weather, in particular, dripping or splashing water, at all times during shipment, storage and construction. Manufacturer's recommendations with regard to storage and protection shall be followed. Should any apparatus be subjected to possible injury by water, it shall be thoroughly dried and put through a dielectric test, at the expense of the Contractor, to ascertain the suitability of the apparatus or it shall be replaced without additional cost to the Owner.
- B. Damaged or Defective Equipment: Inspect all electrical equipment and materials prior to installation. Damaged equipment and materials shall not be installed or placed in service until the Owner has been notified. Replace or repair to new condition and test repaired damaged equipment in compliance with industry standards at no additional cost to the Owner. Equipment required for the test shall be provided by the Contractor.

1.8 WORKING CLEARANCES

- A. Working clearances around equipment requiring electrical service shall comply with code requirements. Should there be apparent violations of clearances, notify the Architect-Engineer before proceeding with connection or placement of equipment.

1.9 COORDINATION

- A. Installation studies shall be made to coordinate the electrical work and to coordinate with the work of other trades.
- B. For locations where several elements of electrical or combined mechanical and electrical work must be sequenced and positioned with precision in order to fit into the available space, prepare coordination drawings at accurate scale showing the actual physical dimensions required for the installation to assure proper integration of equipment with building systems.
- C. Request, in a timely manner, approved shop drawings from all required disciplines and verify final electrical characteristics before roughing power feeds to any equipment. When electrical data on approved shop drawings differs from contemplated design, make the necessary adjustments to the wiring, disconnect, and branch-circuit protection for the equipment actually installed.
- D. Damage from interference caused by inadequate coordination by the Contractor shall be rectified at no additional cost to the Owner.

- E. Access panels required for access to equipment or wiring shall be provided as specified in Division 8.

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INSTALLATION PROCEDURE

- A. Erect equipment parts at such time and in such manner as to minimize interferences and delays in the execution of the work.
- B. Care shall be used in the erection and installation of all equipment and materials to avoid marring surfaces of the work. Damages shall be repaired at no additional cost to the Owner.
- C. Housekeeping pads 3" high must be provided under all floor mounted electrical equipment.
- D. Labels shall be provided for each motor controller, safety switch, relay, panelboard, contactor, timer, control device, meter and circuit breaker. Labels shall be laminated, phenolic strips 1/16 inch thick and engraved to show black letters on white background not less than 1/4 inch in height. Strips shall be of size to properly fit manufacturer's brackets and legible. Where brackets are not provided, labels shall be mounted with screws.

3.2 PLACING EQUIPMENT IN SERVICE

- A. Prior to energization, all equipment connections shall be tight and wiring tested for shorts and opens. Equipment enclosure interiors shall be clean and free of dirt and debris.
- B. Equipment requiring electrical service shall not be energized or placed in service until all interested parties have been duly notified and are present or have waived their right to be present. Where equipment to be placed in service involves service or connection from another contractor or the Owner, the Contractor shall notify the Owner in writing when the equipment will be ready. The Owner shall be notified as far in advance as possible, of the date the various items of equipment will be complete.

3.3 OPENING AND SLEEVES FOR ELECTRICAL WORK

- A. Provide openings through walls, partitions, floors and roofs as required for electrical work.
- B. Provide sleeves for electrical work passing through walls, partitions, floors and roofs, where indicated on the drawings.

1. Sleeves shall extend through floors, walls and partitions and shall be cut flush with each surface unless otherwise specified. Fire wall or floor integrity shall be restored after penetration.
2. Sleeves in concrete and masonry walls, concrete floors and roofs shall be of standard weight steel pipe, finished with smooth edges. Sleeves for walls and partitions other than masonry, concrete and suspended ceilings shall be No. 22 USG galvanized iron.
3. In fire rated floors or walls, all space between the floor or wall and conduit passing through the floor or wall shall be caulked with a fire barrier system classified by UL as a through-penetration firestop device. Acceptable: 3M Brand Fire Barrier Caulk and Putty; T&B Flame-Safe firestop Compound.

3.4 SUPPORTS FOR CONDUIT AND EQUIPMENT

- A. Shall be supported from structural members and not from metal deck and slab assemblies.
- B. All lighting fixtures shall be properly supported to structural members. Provide independent supports for the lighting fixtures. The support shall be in addition to the supports from the ceiling grid system.

3.5 FINAL INSPECTION AND TESTING

- A. The work shall be thoroughly tested in the presence of the Owner's representative to demonstrate that the entire system is in proper working order and in accordance with the drawings and specifications. Each motor with its control shall be run as nearly as possible under operating conditions for a sufficient length of time to demonstrate correct alignment, wiring capacity, speed and satisfactory operation. All main switches and circuit breakers shall be operated, but not necessarily at full load. During final inspection, furnish the test instruments and qualified personnel to perform complete testing.
- B. Costs of tests, including expenses incident to retest occasioned by defects and failures of the equipment to meet the specifications shall be paid by the Contractor.

END OF SECTION 26.05.01

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SECTION 26.05.19 – 600 V CABLE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. The work includes furnishing and installing all wire, cable, and connectors required for the power distribution systems, lighting, motors, mechanical equipment, receptacles and miscellaneous items requiring electrical power.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers of Wire and Cable:
 - 1. Anixter Bros. Inc.
 - 2. Okonite Company.
 - 3. Triangle Wire and Cable.
 - 4. Cablec Corporation.
 - 5. Rome Cable Division of Alcoa.
 - 6. Southwire Corp.
- B. Acceptable Manufacturers of Connectors:
 - 1. AMP Inc.
 - 2. Burndy Corp.
 - 3. O.Z./Gedney Company.
 - 4. Thomas & Betts Company.
 - 5. Ideal Industries.
 - 6. General Electric Company.
 - 7. Minnesota Mining & Mfg. Company.
 - 8. King Technology, Inc.

2.2 MATERIALS

- A. Cable for General Wiring:
 - 1. Except as otherwise indicated, provide 600-volt rating insulated copper cable, copper wire and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as recommended by the manufacturer, meeting ICEA-NEMA Standards.
 - 2. Unless otherwise noted, wire No. 10 AWG and smaller shall be solid, factory-color coded, with type THHN or THWN insulation. Minimum wire size shall be No. 12 AWG except control wiring may be No. 14.
 - 3. Wiring in underfloor ducts, direct burial raceway or damp locations shall be THWN or XHHW insulation.
 - 4. Wire sizes No. 8 and larger shall be stranded with insulation type THHN, THWN, XHHW or specially selected insulation as indicated. Wire shall be factory color coded or coded with tape.

5. All conductor insulation shall be rated for 90 degrees except fixture wire or as noted otherwise.
6. Provide high-temperature fixture wiring for incandescent, mercury and sodium lamp type socket connections.
7. Use following colors for coding:

| <u>208 Volt System</u> | <u>480 Volt System</u> | <u>Equipment Phase Sequence</u> |
|------------------------|------------------------|---------------------------------|
| Neutral - White | Neutral - Gray | ABC, top to |
| Phase A - Black | Phase A - Brown | bottom, left to |
| Phase B - Red | Phase B - Orange | right, front to |
| Phase C - Blue | Phase C - Yellow | back. |

Grounding Conductor - Green

- B. Connectors:
 1. Connectors for splicing of No. 10 AWG and smaller conductors shall be 3-M Scotchlok, spring-type pressure connectors, or approved equal.
 2. Splices for No. 8 AWG and larger shall be T&B compression type, or approved equal.
 3. Terminations for motors with No. 10 AWG or smaller conductors shall be a spring-type pressure connector. Terminations for motors requiring No. 8 AWG and larger terminations shall provide taped connections of compression connectors of motor leads to compression connectors of input conductors, using machine bolt and nut arrangement.
 4. Lug terminations for No. 8 AWG and larger cable shall be with T&B "color-keyed" compression connectors, or approved equal.
 5. Electrical insulating tape shall be Scotch No. 88 or 99, or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification:
 1. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final submittal on equipment to assure proper number and AWG of conductors.

3.2 PREPARATION

- A. Conduit System:
 1. No wire shall be pulled until the conduit system is complete, from pull-point to pull-point, and major equipment terminating conduits have been fixed in position.

3.3 INSTALLATION

- A. Cable:
 1. Cable insulation shall not be disturbed or torn while installing wire in conduits. A neutral lubricant may be used in pulling non-armored conductors and shall be used if wire is pulled by mechanical means.
 2. Bending radius of insulated wire or cable shall be not less than the minimum recommended by manufacturer.
 3. Maximum pulling tension of any wire or cable shall not exceed

manufacturer's recommended values.

4. Color coding is required at termination points and within junction boxes. Where tape is used it shall cover not less than 6 inches of the conductor at panelboards and in each outlet box, junction box or termination. In switchboards, or other enclosures where more than 4 feet of conductor is exposed, conductor shall be taped at entrance to enclosure and at termination.
5. Allow adequate conductor lengths in all junction boxes, pull boxes and terminal cabinets. Any terminated conductor in which the conductor is in tension will be rejected and shall be replaced with conductors of adequate length. This requirement shall not include vertical cable supports in vertical raceway installations provided in pullboxes at proper vertical spacings.

B. Splices:

1. Splices shall not be made except in junction boxes, outlet boxes, or other permanently accessible locations.
2. Installed splices shall have equal to or better mechanical strength and insulation as the factory applied insulation.

3.4 FIELD QUALITY CONTROL

A. Inspection:

1. Prior to energization, check cable and wire for circuit continuity, short circuits, and proper phasing of conductors.

END OF SECTION 26.05.19

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SECTION 26.05.26 – GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

- A. The work includes all grounding for the electrical systems, extending to all electrical items connected with a source of power, including all grounding required by National Electrical Code (NEC). Grounding specified or shown, which exceeds NEC minimums, shall be installed.
- B. Except as otherwise indicated, the secondary distribution system shall include a grounding conductor in all raceways in addition to the return path of metallic conduit.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

- A. All grounding conductors shall be copper conductor material only. Materials shall be in conformity with those specified elsewhere herein for electrical systems. Conductors within the raceway systems shall have same type of insulation as phase conductors and shall be identified as specified herein.

2.2 GROUNDING CONNECTORS AND DEVICES

- A. Connectors and devices used in the grounding systems shall be of copper or bronze materials, and applicable for the use whether specified by manufacturers number herein or otherwise required. Specified items of designated manufacturers indicate required level of quality, equals may be provided if submitted and approved. All connectors and devices shall be compatible with the surfaces being bonded or shall be suitably surfaced or coated and comply with NEC. Items not listed herein shall be of equal quality to the following specified items.
 - 1. Lugs: heavy cast copper or cast bronze, with ground surface equal to Burndy QA-B or T&B equal.
 - 2. Grounding and Bonding Bushings: Malleable iron, Thomas & Betts (T&B).
 - 3. Piping Clamps: T&B.
 - 4. Grounding Screw and Pigtail: Raco No. 983.

2.3 GROUNDING RODS

- A. Ground rods shall be of the sectional driven type, round, cone-pointed, copper clad steel of not less than 5/8 inch diameter. Minimum length shall be 8 feet. All lead connections below grade and in inaccessible locations shall be exothermic welded. Each rod shall be die stamped with identification of manufacturer and rod length. Rods shall be Copperweld or approved equal.

PART 3 - EXECUTION

3.1 GROUNDING CONDUCTOR IDENTIFICATION

- A. Grounding conductors within the raceway systems shall be identified with a green color as follows:
 1. Size No. 8 and Smaller: Continuous green colored insulation.
 2. Size No. 6 and Larger: Green tape for a minimum of 6 inches at terminators in switchboards, cabinets, junction and pull boxes, where passing through pull boxes and at every point where the conductor is accessible.

3.2 INSTALLATION AND METHODS

- A. Except as otherwise indicated, each feeder and branch circuit raceway on the load side of the service entrance shall contain a grounding conductor sized as indicated and where not shown shall be sized in accordance with Table 250-122 of the NEC. Conductor shall be connected to the equipment grounding bus in switchboards and panelboards, to the grounding bus in all motor control centers and as specified, to lighting fixtures, motors and other types of equipment and outlets. The ground shall be in addition to the metallic raceway and be properly connected thereto, using a lug device located within item enclosure at point of electric power connections, to permit convenient inspection.
- B. All panelboards shall be provided with a grounding bus.
- C. Provide green insulation ground for all grounding type receptacles and equipment of all voltages.
- D. Grounding for Lighting Fixtures shall be as follows:
 1. All suspended fixtures and those supplied through flexible metallic conduit shall have green ground conductor from outlet box to fixture. Cord connected fixtures shall contain a separate green ground conductor.
 2. Except as otherwise indicated, freestanding pole mounted lighting fixtures shall each have a Copperweld, or equal, rod located within 24 inches from the concrete base and projecting a minimum of 8 feet below grade. A NEC sized grounding conductor enclosed in conduit shall be used to connect rod with metal pole and a NEC sized conductor also shall be provided from pole to supply panel ground. Conductor shall be thermowelded to rod. Metal poles shall have grounding stud with bolt on interior of pole.
- E. Motors and Equipment: All motors, heating coil assemblies and equipment requiring flexible connections shall have a green grounding conductor properly connected to the frames and extending continuously to the supply source grounding bus with approved connectors thereto regardless of conduit size or type.
- F. Lightning protection system shall be connected to building service ground.

3.3 MISCELLANEOUS GROUNDING CONNECTIONS

- A. All surfaces to which grounding connections are made shall be thoroughly cleaned to maximum conductive condition immediately before connections are made thereto. Exposed bare metal after termination point shall be painted.
- B. Welded or Brazed Connections: Joints in grounding conductors shall be welded or brazed. The welding or brazing processes shall be an exothermic type.

3.4 MAIN ELECTRICAL SERVICE GROUNDING AND BONDING

- A. Ground in accordance with Article 250 of the NEC. Ground rods shall be provided for the main service grounding in sufficient number and configuration as indicated on drawings. Grounding system shall also be extended to the cold water entrance pipe and be grounded to the line side of any metering at property line when water pipe is metallic. Provide slab ground in accordance with local codes and standards requirements.

END OF SECTION 26.05.26

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**SECTION 26.05.29 – RACEWAYS
& ELECTRICAL SYSTEM SUPPORTS**

PART 1 - GENERAL

1.1 SUMMARY

- A. All wiring, unless otherwise indicated, shall be installed in metallic raceway. Minimum size shall be 3/4 inch unless otherwise noted. Raceway system shall be sized to suit number and size conductors to be installed or of size shown, if larger. Size may be increased to facilitate pulling of conductors.
- B. All raceways shall be UL listed for their intended purpose.

1.2 SUBMITTALS

- A. Shop Drawings: Include catalog cuts of raceway, fittings and expansion fittings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. For each electrical raceway system installed, provide a complete assembly of conduit, tubing or duct, with fittings including, but not necessarily limited to, connectors, nipples, couplings, elbows, outlet box covers, expansion fittings, conductor support and other components and accessories as needed to form a complete system of type indicated.
- B. Conduit installed in hazardous area shall be Rigid Steel with threaded fittings.
- C. Conduit installed in concrete shall be Schedule 40 PVC unless noted otherwise.
- D. The following types of conduit shall be installed as listed below unless otherwise permitted by these specifications or the drawings:
 - 1. Rigid steel conduit per Section 26.05.30 - CONDUIT, RIGID STEEL.
 - 2. EMT per Section 26.05.31 - CONDUIT, ELECTRIC METALLIC TUBING.
 - 3. PVC conduit per Section 26.05.32 - CONDUIT, PVC.
 - 4. Flexible metallic conduit and liquid-tight flexible metal conduit per Section 26.05.33 - CONDUIT, FLEXIBLE METALLIC.
 - 5. Surface Metal Raceway per Section 26.05.34 – SURFACE METAL RACEWAY

2.2 CONDUIT HANGERS AND SUPPORTS

- A. Surface mounting conduit supports in interior locations shall be T&B #1210 Series for GRC and T&B #4160 Series for EMT or approved equal in weight and quality.

Surface mounting conduit supports in exterior locations and in service areas shall be one-hole, HDG finish malleable cast iron straps, T&B #1275-1288 with matching spacer, T&B #1350 Series or approved equal in weight and quality.

- B. Suspended Conduits: Steel City #6HO Series or approved equal adjustable hanger for single installations. Multiple conduits shall be trapeze-type hangers where practicable. Support members shall be similar and equal to Unistrut #P-2000/4000, or approved equal, selected for span and loading in accordance with the manufacturer's recommendations, using 2 or more rods of 3/16-inch diameter or greater as required. GRC clamps shall be Unistrut #P-1109 Series, or approved equal. EMT Clamps shall be Unistrut #P-1425 Series, or approved equal.
- C. Above suspended ceiling, single runs of 1-inch conduit or smaller may be run not less than 12 inches above "T" bar with caddy "kon" clip. Only one conduit may be supported per ceiling support wire.

2.3 INSERTS AND ANCHORS

- A. New Concrete Work: Adjustable concrete inserts, Grinnell or approved equal.
- B. Installation in Shear or Compression in Existing Concrete: Phillips Redhead, Pierce, A-J or Diamond.
- C. Concrete Block Walls: Toggle bolt or "molly" anchors. Where loads require, provide thru-bolts and 3/16 inch thickness backup plates, properly concealed.
- D. Steel Beam Clamps: Steel City #500 Series or approved equal.
- E. Where loads require, provide galvanized structural steel framework, secured to structure above in an approved manner.

2.4 PULL LINE

- A. Shall be polyolefin pull line, Jet Line No. 232, or approved equal.

2.5 MARKING RACEWAY SYSTEM

- A. Where raceway is located below grade or slab, provide marking tape. Tape shall be equal to Carlon Mat standard tape or approved equal.
- B. Raceways and junction boxes for various systems shall be identified by colored conduit or 3 inches of color tape or paint at 20 feet intervals as follows:
 - 1. Fire Alarm System: Red.
 - 2. Intercom System: Blue.
 - 3. Communications/Data System: Gray.
 - 4. Security System: Black.

2.6 CONDUIT TERMINATIONS

- A. All conduit terminations in damp, wet, or hazardous locations shall be with threaded

conduit hub.

- B. All conduit terminations from or in hazardous classified areas shall have the seal fittings installed as are required by NEC Articles 500 and 501.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Concealed conduits shall be run in walls and overhead in ceiling space or slab above unless specifically indicated to be run in floor. All conduits shall be run down to outlets to avoid trapped runs wherever possible.
- B. Exposed conduits and conduits in ceiling space shall be run parallel to building lines and supported as high as possible.
- C. Where conduits turn out of or penetrate a slab, they shall be not less than 2-1/2 inches on center. Maximum size raceway concealed in concrete slabs shall be 3/4 inch trade size in suspended slabs of 2-1/2 inch thickness, and 1 inch trade size in suspended slabs of 4 inch thickness, all at center of slab. Conduits shall be installed so that only 2 cross at a given point and sufficiently within slab to prevent slab cracking. Route conduit on hangers below ceiling in locations specifically approved by the Architect-Engineer.
- D. Field bends shall be made with tools designed for conduit bending. Heating of metal conduit to facilitate bending is not permitted. Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Crushed or deformed raceways shall not be installed.
- E. Conduit shall be secured in place and protected where necessary to prevent damage to the work during construction. Ends of conduit runs shall be plugged with cork, oakum, or other approved devices to avoid entrance of plaster, concrete or other debris.
- F. Where conduit installed in concrete or masonry extends across building expansion joints, expansion fittings as manufactured by OZ, Crouse-Hinds, or Appleton, with approved ground straps and clamps, shall be provided.
- G. Location and sizing of conduit sleeves passing through floors and walls that are not shown on the drawings shall be the responsibility of the Contractor.
- H. Field cuts on conduit shall be made with a hand or power saw or approved conduit machine, and shall be made square. All male threads shall be painted with red or white lead before fittings are applied.
- I. Conduit parallel to, or crossing over, un-insulated hot water pipes shall be separated 12 inches if parallel or 7 inches if crossing. Where hot water pipe lines are insulated, parallel or crossing conduit shall clear the insulated surface by 2 inches. Conduit shall not be run directly under cold water lines and shall be separated in other

directions by at least 3 inches.

- J. Conduit shall not be secured directly to other piping. Support conduit with separate supports directly from building structure.
- K. Conduit bushings shall be of the nylon insulating type. Empty conduits shall terminate with smooth insulating bushings or be capped with blanks and bushings.
- L. Conduit seals and firestops shall be provided where conduits are installed under the hangar floor rises up into a space, where required by codes and where passing from an air conditioned space to non-conditioned space. Where conduits terminate in a pull-box or outlet box at a point separating the air conditioned space from the non-conditioned space, conduit end may be stuffed with fiberglass. If the conduit run is to be continuous, install conduit outlet or junction box and seal as above.
- M. Raceway shall be supported at intervals of not more than 8 feet, with pipe straps, wall brackets, strap hangers, ceiling trapeze, toggle bolts through concrete or tile blocks, expansion bolts in concrete or brick and machine screws or welded studs on steel work. Wooden plugs in concrete and masonry are not acceptable. Raceways and pipe straps shall not be welded to steel structure members.
- N. Conduit installation shall follow layout shown on drawings. Layout is, however, diagrammatic only and where changes are necessary due to structural conditions, interference with other apparatus or other causes, such changes shall be made without additional cost to the Owner. Offsets in conduits are not indicated but shall be installed as required by the conditions.
- O. Pull lines shall be installed in empty raceways.
- P. Verify exact stub up location and termination requirement for all power and control circuits for all items and equipment being served.
- Q. Separate raceway systems shall be provided for conductors or systems in accordance with the following, except as otherwise indicated on the drawings:
 - 1. Each lighting panelboard distribution system.
 - 2. Each receptacle panelboard distribution system.
 - 3. Each item of building equipment.
 - 4. Each special system, including battery lighting, emergency and exit wiring, control, data, signal and communication.
 - 5. Air conditioning controls.
- R. Conduits shall be concealed in all locations except:
 - 1. Electrical and mechanical equipment spaces.
 - 2. Where specifically noted as having conduits located on wall surfaces or exposed to view overhead.
- S. Provide expansion fittings in long runs as necessary for contraction and expansion movement, and at each building expansion joint, whether conduits are within or below slabs.

- T. There shall be no more than four, 90-degree bends or 100 feet between wiring pulling points. For voice/data cables or coaxial type and other special construction, pullboxes shall be installed after each two, 90-degree bends or equivalent summation of bending degrees. Conduit system layout shall be approved at the site by the installer of the cables to be contained, whether or not these cables are installed under this contract. The intent is to require raceway layouts and fittings which will permit insertion of these special cables without degradation of the electrical properties required of these cables. Where conduits are installed rendering proper cable installation impossible, conduits shall be replaced with new conduits at no additional cost to the Owner.
- U. Conduits shall not be installed to result in less than 7 feet, 6-inch headroom without specific approval of the Architect-Engineer.
- V. All exposed conduit runs and conduit runs above ceiling shall be run as high as possible with offsets and bends to clear obstructions.
- W. Marking tape over conduit runs below slab or paved area shall be 2 inches below slab or pavement. In all other areas, tape shall be minimum 12 inches below finished grade.
- X. Where conduits and outlet boxes are indicated in reinforced columns or beams, coordinate conduit runs and box locations with placement of reinforcing steel.

END OF SECTION 26.05.29

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**SECTION 26.05.30 - CONDUIT,
RIGID STEEL**

PART 1 - GENERAL

NOT USED

PART 2 - PRODUCTS

2.1 STEEL CONDUIT

- A. Shall be manufactured in accordance with ANSI C80.1, Specifications for Rigid Steel Conduit, Zinc Coated.
- B. Shall be listed to UL 6

2.2 FITTINGS

- A. Shall be threaded, galvanized or Sherardized for steel conduit and shall be manufactured in accordance with ANSI C80.4, Specifications for Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as specified and in compliance with manufacturer's instructions.
- B. At couplings, conduit ends shall be threaded to meet in coupling. Split couplings and right and left couplings shall not be used.
- C. Rigid steel conduit, couplings, elbows and fittings shall not be installed below grade unless asphaltum or PVC coated, where in direct contact with earth. Bare conduit installed in direct contact with earth shall be thoroughly coated with two coats of asphaltum. All wrench marks on asphaltum-coated conduits shall be touched-up with asphaltum. Wrench marks, scuffs or cuts on PVC coated conduit shall be covered with Robroy Plasti-bond, or approved equal, coating material.
- D. Rigid elbows installed in direct contact with earth for direct buried PVC work, shall be asphaltum or PVC coated.
- E. Except where conduits are contained within a specific structural column for service to outlets contained therein, conduits shall not pass through or below column footings.
- F. Rigid steel conduit shall be for exterior and hazardous area applications.

3.2 SUPPORTS

- A. Support conduit in compliance with Table 344-30(B)(2) of the National Electrical Code, 2011 issue. Where conduit racks are used, do not bundle or lay conduit on top of each other. A minimum of 1/8 inch spacing shall be maintained between parallel runs.

END OF SECTION 26.05.30

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**SECTION 26.05.31 – ELECTRICAL
METALLIC TUBING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Refer to Division 16, Section 26.05.01 - ELECTRICAL WORK, GENERAL for general requirements.
- C. Refer to Division 16, Section 26.05.29 – RACEWAYS & ELECTRICAL SYSTEM SUPPORTS for conduit general requirements.

PART 2 - PRODUCTS

2.1 ELECTRIC METALLIC TUBING (EMT)

- A. Shall be manufactured in accordance with ANSI Standard C80.3, - Specifications for Electrical Metallic Tubing, Zinc Coated.
- B. Shall comply with National Electric Code 2011 Article 358
- C. Shall be listed to UL 797

2.2 FITTINGS

- A. Fittings shall be in accordance with ANSI Standard C80.4, - Specifications and fittings for Rigid Metal Conduit and Electrical Metallic Tubing. Fittings shall be compression type; set screw type fittings will not be accepted. EMT fittings shall be malleable iron or steel, rain and concrete-tight as appropriate. Pot metal or die cast type and "sock-on" type fittings shall not be used.
- B. Connectors shall have nylon insulated throats.
- C. Conduit supports and clamps shall be corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. EMT shall be installed in accordance with the manufacturer's instructions and National Electric Code requirements.

- B. EMT shall not be installed in concrete slabs, light standard bases, below grade, or in locations where rigid steel conduit is specified or required.
- C. Use EMT only for interior applications.

3.2 SUPPORTS

- A. Support conduit in compliance with National Electric Code Installation requirements. Where conduit racks are used, do not bundle or lay conduit on top of each other. A minimum of 1/8-inch spacing shall be maintained between parallel runs.

END OF SECTION 26.05.31

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**SECTION 26.05.32 -
CONDUIT-PVC**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Refer to Division 16, Section 26.05.01 - ELECTRICAL WORK, GENERAL for general requirements.
- C. Refer to Division 16, Section 26.05.29 – RACEWAYS & ELECTRICAL SYSTEM SUPPORTS for conduit general requirements.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Type PVC conduit shall be made of polyvinyl chloride, complying with NEC (2011) 352. Conduit shall be sunlight resistant.
- B. Type PVC conduit shall be manufactured to Federal Specification WC1094A, and meet NEMA TC-2, and UL 651 requirements.
- C. Type PVC conduit shall conform to ASTM D1784.
- D. PVC conduit shall be type A in schedule 40 weight for concrete encasement or schedule 80 weight for use where subject to physical damage.

2.2 FITTINGS

- A. Type PVC conduit fittings shall comply with NEC (2011) 352 and shall be manufactured to Federal Specification WC1094A, and meet NEMA TC-3, and UL 514B requirements.
- B. Type PVC conduit fittings shall be Schedule 40, socket type, solvent weld, complying with ASTM D2466 and installed per manufacturer's instructions. Joints shall be watertight.
- B. Threaded type fittings may be used provided joints are made watertight. Fittings shall be Schedule 80, complying with ASTM D2464.
- C. Transition from PVC to galvanized rigid conduit shall be by threaded fitting.

- D. Provide an expansion coupling for aboveground installations where temperature change in excess of 14°C (25°F) is anticipated or whenever the change in length due to temperature variation will exceed 1/2 in. Install coupling per manufacturer's instructions.

2.3 SOLVENT

- A. For solvent weld connections, use low VOC PVC solvent cement as recommended by the conduit and fitting manufacturer. Solvent cement shall be in compliance with ASTM D2564.
- B. Do not use solvent welded connections where ambient temperature is below 40° F (5° C)

2.4 BENDS

- A. Bends on conduit runs exceeding 50 feet shall be noncorrosive metallic. Bends on short runs shall be factory or field fabricated using manufacturer approved, heat applied methods.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install where shown on drawings and in compliance with manufacturer's instructions. Bends shall be smooth and uniform.
- B. PVC conduit may be used in below-grade applications. All bends, elbows and risers shall be rigid galvanized and shall be asphaltum or PVC coated below grade.

3.2 JOINTING

- A. Pipe and fittings shall be solvent welded or threaded and made watertight.

3.3 SUPPORTS

- A. Support conduit in compliance with National Electrical Code (2011) Table 352.30. Where conduit racks are used, do not bundle or lay conduit on top of each other. A minimum of 1/8 inch spacing shall be maintained between parallel runs.

END OF SECTION 26.05.32

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**SECTION 26.05.33 – CONDUIT-
FLEXIBLE METALLIC**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Refer to Division 16, Section 26.05.01 - ELECTRICAL, GENERAL for general requirements.
- C. Refer to Division 16, Section 26.05.29 – RACEWAYS & ELECTRICAL SYSTEM SUPPORTS for conduit general requirements.

PART 2 - PRODUCTS

2.1 FLEXIBLE METALLIC CONDUIT (FMC)

- A. Flexible Metal Conduit shall be manufactured in compliance with the National Electric Code (2011) 348 and listed to UL-1 “Standard for Flexible Metal Conduit”. Conduit shall be made of Hot Dip Zinc Galvanized Steel.
- B. Flexible Metal Conduit in trade sizes 3/8” through 4” may be used; length of 3/8” is limited to 6 feet per NEC 348.20.
- C. FMC connectors shall be galvanized steel or malleable iron and in compliance with NEMA FB-1 and NEMA FB-2.

2.2 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC)

- A. Liquidtight Flexible Metal Conduit shall be manufactured in compliance with the National Electric Code (2011) 350 and listed to UL-360 “Standard for Liquidtight Flexible Metal Conduit”.
- B. Liquidtight Flexible Metal Conduit shall have hot dipped zinc galvanized steel core and continuous, PVC cover. Conduit shall be Anaconda Sealtite® type UA or type EF or approved equal.
- C. Flexible Metal Conduit in trade sizes 3/8” through 4” may be used; length of 3/8” is limited to 6 feet per NEC 350.22.
- D. Connectors shall be T&B liquid-tight, with nylon insulated throat, galvanized steel, malleable iron or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Flexible metallic conduit shall be used for connection from junction box, conduit or motor controllers to equipment and motors, panelboards to transformers, subject to continuous vibration or where the location of the connection is such that it is impractical to make a rigid conduit connection and from junction boxes to recessed lighting fixtures.
- B. Liquid tight flexible metallic conduit shall be used for exterior locations, food preparation areas, motors internal in air handling equipment and other locations subject to dampness.
- C. Length of flexible metallic conduit between equipment and conduit termination shall not exceed 24 inches or be less than 12 inches for sizes 1/2 inch to 2 inches. For 2-1/2 inches and larger, maximum length shall be 4 feet and minimum length shall be 18 inches. Specific instances and construction constraints which will require variance from the above shall be approved by Architect-Engineer prior to placement of conduits.
- D. All uses must comply with NEC article 250.

END OF SECTION 26.05.33

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**SECTION 26.05.36 – BOXES
AND FITTINGS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Refer to Division 16, Section 26.05.01 - ELECTRICAL WORK, GENERAL for general requirements.

1.2 SUMMARY

- A. Section includes furnishing and installing outlet boxes, floor boxes, pull boxes and junction boxes, including fittings and accessories, required for all raceway systems.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data showing proposed material and compliance certifications.
- B. Shop Drawings: Submit complete shop drawings as required to determine acceptability of special boxes. Identify dimensions, Locations, materials, and fabrication and finishing requirements.

1.4 REFERENCES

- A. Federal Specifications (FS)
 - 1. FS W-C-586 Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical Cast Metal
 - 2. FS W-S-865 Switch Box (Enclosed), Surface Mounted
- B. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 2. NEMA OS 1 Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
 - 3. NEMA OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 70 National Electrical Code (NEC)
- D. Underwriters Laboratories (UL)
 - 1. UL 50 Cabinets and Boxes
 - 2. UL 514A Metallic Outlet Boxes
 - 3. UL 514B Fittings for Conduit and Outlet Boxes
 - 4. UL514C Nonmetallic Outlet Boxes, Flush Device Boxes, and Covers

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Materials shall be manufactured by firms regularly engaged in the manufacture of UL listed electrical boxes of the types and sizes required, and whose products have been in satisfactory use for not less than five years.
- B. Compliance: Boxes and fittings shall comply with all applicable requirements of Federal, NEC, NEMA, and UL standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following, or an approved equal:
 1. Steel City.
 2. Raco.
 3. Thomas & Betts.
 4. Square D.
 5. Raceway Components, Inc.
 6. Carlon.
 7. Appleton.
 8. Crouse-Hinds.
 9. Spring City.
 10. Pilla.
 11. Red Dot.

2.2 MANUFACTURED UNITS

- A. Concealed Outlet Boxes:
 1. Except where cast type boxes are specified or required, provide standard galvanized steel outlet boxes at each concealed outlet for lights, switches, wall receptacles, and similar devices. Boxes and covers shall be not less than code gauge thickness steel. Box shape and dimensions shall be selected for the specific use and location.
 2. Ceiling outlet boxes shall be not less than 4 inches octagonal by 2 inches deep.
 3. Switch and receptacle outlet boxes shall be not less than 4 inches square by 1-1/2 inches deep with standard device covers. Boxes in exposed masonry shall be square corner type. Thru-wall boxes shall not be installed in any location except as specifically permitted.
- B. Device Covers:
 1. Provide suitable device covers as required for concealed wiring boxes.
 2. Provide 1-inch deep device cover for flush outlet boxes to be installed in areas where concrete will be exposed after construction is complete.
 3. Provide device covers of sufficient depth for boxes without square corners to be installed wholly within cavity of masonry.
- C. Exposed Outlet Boxes:
 1. Exposed outlet boxes in damp locations and boxes located outdoors shall be cast or malleable iron or cast aluminum and shall have threaded hubs.

Exposed outlet boxes used with aluminum conduit shall be of aluminum alloy containing less than 1 percent copper.

- D. Individually Mounted Floor Boxes:
 - 1. Provide steel, concrete tight adjustable leveling type floor boxes for floor outlets, with vertical adjusting rings, leveling screws, and gaskets.
 - 2. Boxes shall be provided with carpet flanges where needed and all accessories required for the specific application.
 - 3. Floor boxes shall be Steel City 664 or approved equal by Raceway component.
- E. Combination Floor Boxes:
 - 1. Provide recessed floor box with space for both high tension and low tension wiring. Height of box to be fully adjustable both prior to and after pouring of concrete. Hinged access cover shall be designed to accept floor covering and to be operable without exposing any metal parts.
 - 2. Floor box shall be 14-gauge, cold-rolled steel galvanized with corner supports and leveling screws. Box shall have duplex receptacle as specified in Section 26.27.26 - WIRING DEVICES.
 - 3. Box shall have cast aluminum or brass cover and leveling ring. Floor box assembly shall meet or exceed UL514A Scrub Water exclusion requirement.
- F. Weatherproof and Watertight Outlet Boxes:
 - 1. For exterior locations and areas subject to moisture or water provide corrosion-resistant, cast metal, waterproof boxes as applicable. Boxes shall be of types, shapes and sizes required, shall be gasketed and have threaded hubs for conduit. Box accessory materials shall match the box for the specific application.
- G. Junction and Pull Boxes:
 - 1. Provide galvanized sheet steel junction and pull boxes, with screw secured covers unless otherwise noted of the type shape and size, to suit each respective location and installation, with welded seams and equipped with nuts, bolts, screws and washers approved for the specific application. Hinged cover boxes similar to Hoffman Bulletin A-90 shall be provided where indicated on the drawings.
 - 2. Material thickness of boxes shall be:
 - a. Up to 12-inch by 12-inch size: No. 14 gauge.
 - b. Over 12-inch by 12-inch size: No. 12 gauge.
 - 3. Covers shall be the same thickness as the box material and shall be reinforced where required by size.
- H. Box Accessories:
 - 1. Provide outlet box accessories as required for each installation, including mounting brackets, hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes compatible with outlet boxes being used and meeting requirements of individual wiring conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Boxes:

1. Install boxes for concealed wiring in an accessible location with suitable device cover as required.
2. Where boxes are installed in concrete which will be exposed after construction is complete, set box and device cover in position before concrete is poured so that concrete will surround and a cover plate can be installed flush upon the unfinished surface.
3. Where boxes are installed in block or tile, provide square cornered boxes or boxes fitted with device covers wholly within the cavity of the block or tile. Neatly saw out an opening for the device cover so that no mortar is required to fill between ring and construction. Verify with counter top heights and equipment dimensions.
4. In no instance, except as specifically approved by the D.P. in cases of special application, shall outlet boxes be installed back to back, nor shall outlets on each side of a wall be provided by use of two device covers and a "thru-wall" box. Each outlet shall have its separate, closed-back box. Outlet box depth shall be to permit installation of block or tile face on rear, including plaster finish conditions. Boxes shall be staggered horizontally, with offset conduit stubs between as required.
5. Provide knockout closures to cap unused knockout holes where blanks have been removed.
6. Locate boxes so as to ensure accessibility of electrical wiring.
7. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
8. Light fixtures, receptacles, equipment connections and other conduit termination shall be provided with outlet boxes.
9. Recessed mounted boxes shall not extend beyond the finished face of the wall nor be recessed into the wall more than 1/4 inch.

B. Special Techniques:

1. In suspended ceilings where outlet boxes support fixtures in instances in which the ceiling-suspension system does not have sufficient strength to prevent visible deflection of the ceiling surfaces, the boxes shall be supported directly by structural members, secured to building structure.
2. Boxes and supports shall be fastened to wood with wood screws or screw type nails of equal holding strength; to concrete or brick with bolts and expansion shields; to hollow masonry units with toggle bolts; and to steel work with machine screws or welded studs. Powder charge-type fasteners may be used in lieu of the above, except where otherwise specifically prohibited.
3. In open overhead spaces, cast metal boxes threaded to raceways need not be separately supported except where used for fixture support. Support cast metal boxes having threadless connectors and sheet metal boxes directly from the building structure or with bar hangers.
4. Where conduit supported outlet boxes are installed and conduit suspended from the structure with hangers, the hangers shall be attached to raceways on opposite sides of the box and shall be supported with an approved type fastener not more than 24 inches measured each side from the box. In addition, the box shall be adequately supported to the structure.
5. Fastenings shall not penetrate more than 1-1/2 inches into reinforced concrete beams or more than 3/4 inch into reinforced-concrete joists and shall not contact main reinforcing steel.

C. Location:

1. The approximate outlet locations are shown on the drawings. The exact locations shall be determined at the building site. The right is reserved by the Owner to change, without additional cost to the Owner, the exact location of any switch, ceiling or other outlet in any space before it is permanently installed. Unless otherwise indicated or directed, place or center outlet boxes at the following distances above finished floor. Mounting height shall comply with ADA.

| | |
|---------------------------------|---|
| Switch outlets | 4 ft. maximum |
| Wall receptacles | 1 ft. 4 in. |
| Wall mounted telephone outlets | 4 ft. 6 in. |
| Interior and exterior brackets | As indicated or directed |
| Water cooler receptacles | Approximately 2 ft. and concealed within the water cooler |
| Emergency alarm pulls stations | 4 ft. maximum |
| Emergency alarm horns or lights | 80 in. above finished floor to the bottom |
| Emergency shut trip stations | 5 ft. |

END OF SECTION 26.05.36

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**SECTION 26.05.73 –
MANUFACTURER'S ENGINEERING
SERVICES**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for manufacturer's engineering services to assist in energizing and testing all busway and switchboard and providing breaker coordination and short circuit systems studies.

1.2 SUBMITTALS

- A. Instruction Manuals: Refer to Division 26, Section 26.01.20 - INSTRUCTION AND MAINTENANCE MANUALS.
- B. System Coordination and Short Circuit Study Report: Submit six copies of final report. Report shall be submitted within 60 days following award of purchase order.

1.3 INSTALLATION AND SERVICE ENGINEERING

- A. The manufacturer of the switchboard and busway shall provide an experienced Field Service Engineer to accomplish the following tasks:
 - 1. Inspection: Visually inspect all busway, switchboard and breakers upon completion of installation and prior to energization to assure that wiring is correct, interconnections complete and installation is in compliance with manufacturer's criteria.
 - 2. Provide engineering support during the energization and check out of busway and switchboard. Perform any calibration or adjustment necessary for the equipment to meet performance specifications.
 - 3. Field Service Engineer shall be at job site a minimum of 16 hours, and longer if necessary, to fulfill testing/inspection requirements.

1.4 SYSTEM STUDIES

- A. Perform the studies described below and submit 6 copies to Architect within 60 days after award of purchase order. At time of submission, provide competent systems engineer to review findings and recommendations.
 - 1. Short Circuit Study: Shall be performed on a digital computer to check the adequacy and to verify correct application of circuit protective devices and other system components specified. Include representation of the power company's system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line and impedance diagrams, conclusions and recommendations. Short circuit momentary duties, when applicable, and interrupting duties shall be calculated on the basis of an assumed bolted three-phase short circuit at each low-voltage bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant

locations throughout the systems. The short circuit tabulations shall include significant X to R ratios, asymmetry factors, kVA, and symmetrical fault current.

2. Coordination Study: Provide a protective device time-current coordination study with coordination plots of key or limiting devices plus tabulated data including ratings or settings selected. In the study, a professional engineering balance shall be achieved between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity, and speed. As applicable, the coordination plots required shall graphically indicate the coordination proposed for the several systems centered on full scale log forms. The coordination plots shall include complete titles, representative one-line diagrams and legends, associated power company's relay or system characteristics, significant motor starting characteristics, complete operating bands for low-voltage circuit breaker trip devices, fuses, as applicable, and the associated system load protective devices. The coordination plots shall define the types of protective devices selected, together with the proposed pick-up settings required. The short-time region shall indicate the low-voltage circuit breaker and instantaneous trip devices, fuse manufacturing tolerance bands, and significant symmetrical and asymmetrical fault currents. Low-voltage power circuit breakers shall be separated from each other, where feasible, by a 16 percent current margin for coordination and protection in the event of secondary line-to-line faults.
3. Report: Include recommendations for changes in device short circuit ratings where deemed necessary. Include, in tabulated form, recommended device time delay and pick-up settings for switchboard breakers and for breakers with adjustable instantaneous trip range.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 26.05.73

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**SECTION 26.09.24 –PROGRAMMABLE
CIRCUIT BREAKER LIGHTING CONTROL**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The work covered in this section is subject to all the requirements in the General and Supplemental Conditions and Division 1 of the Specifications.
- B. The contractor shall coordinate all of the work in this section with all trades covered in the other sections of the specifications to provide a complete and operable system.

1.2 SUMMARY

- A. The lighting control system consists of central programmable circuit breaker control together with remote switches and sensors input controlling indoor and outdoor light levels in individual zones as is indicated by the drawings. The requirements of this section includes, but is not limited to, programmable circuit breaker panels, lighting level sensors, occupancy sensors, power packs and auxiliary relays.
- B. System installation includes the installation and programming of the system in accordance with manufacturer's installation instructions. Provide programming equipment and related hardware and software to allow complete programming of the lighting controls as shown on the drawings and specifications.

1.3 REFERENCES

- A. National Electrical Manufacturers Association (NEMA)
 - NEMA 250 Electrical Enclosures for Electrical Equipment
 - NEMA ICS 1 General Standards for Industrial Controls and Systems
 - NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies
 - NEMA PB 1 Panelboards
- B. National Fire Protection Association (NFPA)
 - NFPA 70 National Electric Code (NEC)
- C. Underwriters Laboratories (UL)
 - UL 20 General Use Duty Snap Switches
 - UL 50 Cabinets and Boxes
 - UL 67 Panelboards

| | |
|---------|---|
| UL 244A | Solid State Controls for Appliances |
| UL 486A | Wiring Connectors and Soldering Lugs for Use with Copper Wire |
| UL 508A | Industrial Control Equipment |
| UL 916 | Energy Management Equipment |

1.4 SUBMITTALS

- A. Product Data Sheets: Submit manufacturer's data sheet for the lighting control system and each of the specified components
- B. One Line Diagram: Submit a one-line diagram of the system configuration proposed if it differs from that illustrated in the riser diagram included in these specifications
- C. Typical Wiring Diagrams: Submit typical connection diagrams for all components including, but not limited to, panelboards with programmable and non-programmable circuit breakers, low voltage switches, occupancy sensors, light level controllers, communications devices, and personal computers
- D. Panel Drawings: Submit manufacturer's dimensional drawings and circuit breaker placement locations for each panelboard

1.5 QUALITY ASSURANCE

- A. Component Testing: All electronic component board assemblies are to be factory tested and burned in prior to installation.
- B. Manufacturer: All system components shall be provided by a single manufacturer to the extent possible. The manufacturer shall be a firm engaged in the manufacture of lighting control equipment and ancillary equipment, of the types indicated, whose products have been in satisfactory use in similar service for not less than five years
- C. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
- D. NEC Compliance: Comply with applicable portions of the NEC.
- E. UL Compliance: UL Listed in compliance with applicable UL Safety Standard.
- F. FCC Emissions: All assemblies are to be in compliance with FCC Part 15, Class B.

1.6 WARRANTY

- A. Manufacturer shall warrant specified equipment to be free from defects in materials and workmanship for at least 1 year from the date of installation.

- B. Factory remote support shall be available free of charge during normal business hours

1.7 DELIVERY AND STORAGE

- A. Deliver all materials in manufacturer's packing in undamaged condition.
- B. Store all materials in dry place and protect them from damage and the elements until installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Schneider Electric or a comparable product by one of the following
 1. Eaton Pow-R-Command
 2. Lighting Control & Design
 3. Schneider Electric / Square D PowerLink
 4. Approved Equal

2.2 PASSIVE INFRARED (PIR) OCCUPANCY SENSOR

- A. Sensor shall be commercial grade rated 120VAC and 277VAC input at line frequency of 60 hertz. Sensor shall not require a neutral connection or minimum load
- B. Sensor shall be rated for electronic and magnetic ballasts, incandescent and motor loads.

| | Load Rating @ 120V | Load Rating @ 277V |
|--------------|--------------------|--------------------|
| Ballast | 1000VA | 1800VA |
| Incandescent | 1000W | |
| Motor | 1/4hp | |

- C. Sensor shall employ a dual element PIR sensor having highest sensitivity to infrared with wavelength of 9.8 microns to detect human occupancy.
- D. Coverage pattern and sensitivity shall be verified in accordance with NEMA WD-7 Guide for Occupancy Sensors.
- E. Sensor shall have a bypass and time delay adjustment located behind a removable cover. A tool is required to remove cover, activate sensor bypass or adjust time delay.

- F. Sensor shall have time delay adjustment ranging from 15 seconds to 30 minutes.
- G. Wall mounted sensor shall include mounting hardware, decorator wall plate cover and screws to mount cover. Wall plate cover color shall match the sensor.
- H. Sensor shall have an Auto/Off latching push button allowing user to turn off lighting (off) in the out position, and enable the sensor to turn lighting on and off automatically in the in position (auto-on).

2.3 DUAL TECHNOLOGY (DT) OCCUPANCY SENSOR

- A. Sensor shall incorporate all the features of the PIR Occupancy Sensor described above. PIR technology shall be used to initiate occupancy mode.
- B. Sensor shall also incorporate a sound technology to sense continued occupancy with room obstructions.

2.4 POWER PACK & AUXILIARY RELAY

- A. Power pack and auxiliary relay shall be rated for 120VAC and 277VAC loads at line frequency of 60Hz.
- B. Power pack shall have an input voltage selector switch to select 120VAC or 277VAC input and switch shall require a tool.
- C. Power pack shall supply 100mA@24VDC to power class 2 sensors and auxiliary relays.
- D. Power pack and auxiliary relay shall have plenum rated enclosure.
- E. Power pack and auxiliary relay shall have separate threaded ½ in. chase nipples for class 1 and class 2 wiring, allowing both power pack and auxiliary relay to be mounted in or out of a standard 4 in. x 4 in. junction box, and providing separation of class 1 and class 2 wiring. Power pack and auxiliary relay may be mounted between two junction boxes, allowing both class 1 and class 2 wiring to be enclosed in conduit as may be required by code.
- F. Power pack and auxiliary relay shall incorporate one relay rated no less than 16A for tungsten filament incandescent lighting loads and 20A for fluorescent ballast loads at either 120 or 277VAC 60Hz.
- G. Power pack and Auxiliary relay shall have a 24VDC control input to allow class 2 sensors to turn on lighting connected to power pack or auxiliary relay.

2.5 PHOTOCCELL

- A. Provide outdoor rated adjustable light level sensor for automatic operation of outdoor lighting via lighting control panel.

- B. Provide indoor rated light level sensors as indicated on the drawings for indoor lighting level control.

2.6 PANELBOARD CONTROL

- A. Controller: Provide panelboard mounted, microprocessor based, intelligent lighting system programmable controller. Controller shall include a front panel backlit LCD display and lockable keypad for local setup, access to configuration, status and diagnostics display. Controller shall also include an RS232 port for Laptop computer communication. Controller and power supply shall be UL 916 listed.
- B. External Control Input: Integral 24Vdc NEC Class 2 power supply for sensing input contact status. Inputs configurable for status feedback to operate indicator lights or actuate control equipment. Input types:
 - 1. Momentary NO
 - 2. Momentary NC
 - 3. Momentary / Maintained Toggle
 - 4. Momentary ON / Momentary OFF
 - 5. Dual Momentary
 - 6. Eight 3-wire / Sixteen 2-wire
- C. Programmable Functions:
 - 1. Astronomic Time Clock with NTP synchronization, calendar and automatic daylight savings adjustment
 - 2. ON / OFF Delay
 - 3. Blink Notification
- D. Network Functions
 - 1. RS232 / RS485 Communication
 - 2. Ethernet
 - 3. BACnet Protocol

2.7 REMOTELY OPERATED CIRCUIT BREAKERS

- A. General: Remotely operated circuit breakers shall match standard panelboard circuit breakers in size and AIC rating, and provide identical overcurrent protection. Features include:
 - 1. UL 489 listed
 - 2. UL HID, SWD, & HACR listed
 - 3. Bolt-on connectors
- B. Operation: Remote operation is via a 24Vdc motor with the following characteristics:
 - 1. True RMS current sensing
 - 2. Remote operation disabled when circuit breaker is manually OFF or Tripped

3. Manual Override selector disables remote operation motor
4. Contact Status Indicator

2.8 SOFTWARE

- A. All initial programming and editing to be accomplished using laptop computer furnished by system installer. User interface must be intuitive and easy to use.
- B. System access shall be via network connected computer and must be password protected. System shall include:
 1. Configuration File backup
 2. Alarm setup and notification
 3. ON-time reporting
 4. Report printing

2.9 SUPPORT SERVICES

- A. System Startup: Manufacturer shall provide a trained technician to confirm proper installation and operation of all system components.
- B. Training: Manufacturer shall provide factory-trained application engineer to train Owner personnel in the operation and programming of the lighting control system.
- C. Documentation: Manufacturer shall provide system documentation including:
 1. System 1-line showing all panels, number and type of switches and sensors, data line, programmable system switches, and central PC.
 2. Drawings for each panel showing hardware configuration and numbering.
 3. Panel wiring schedules.
 4. Typical wiring diagrams for each component.
- D. Programming: Manufacturer shall provide system programming including:
 1. Wiring documentation.
 2. Programmable panel and system switch operation.
- E. Extended Warranty: Manufacturer shall provide a 2-year extended warranty of all system components.
 1. For the first year after installation all parts, labor and programming services shall be provided at no charge by the electrical Contractor.
 2. Extended 2-year warranty period shall begin at the end of the first year of operation.
 3. During the extended 2-year warranty period, all parts, labor and programming services shall be provided at no charge to the Owner by the factory-trained service Contractor who initially installed the system.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Review lighting control layout with manufacturer's factory representative / application engineer. Verify all required system components and submit final shop drawings per manufacturer's installation requirements to engineer.
- F. Install system per manufacturer's instructions. Provide wiring, conduit and wireway for connection of indicated circuits to the panels and to the load served.
- G. Provide 120 VAC receptacles for power supply as required

3.2 STARTUP

- A. Provide checkout of all system hardware by a factory-trained technician.
 - 1. Check that all lighting panels are properly installed and loads recorded on schedule cards.
 - 2. Check panel address settings and confirm communications at each panel.
 - 3. Check for proper wiring and data transmission by programmable system switch
 - 4. Repair or replace any defective components.
 - 6. Provide certification indicating the check out of the system by factory trained technicians.
- B. Provide training for Owner's personnel by a factory applications engineer.

END OF SECTION 26.09.24

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SECTION 26.22.13 – TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Refer to Division 26, Section 26.05.01 - ELECTRICAL WORK, GENERAL for general requirements.

1.2 SUMMARY

- A. Providing general-purpose transformers, dry type.
- B. Provide K-rated, dry type where indicated.

1.3 SUBMITTALS

- A. Shop drawings shall be submitted consisting of certified outline drawings and wiring diagrams. Include data on insulation, isolators, sound levels, losses, impedance "K" factor and regulation and, for isolation transformer, submit attenuation of interference and undesirable frequencies.

1.4 QUALITY ASSURANCE

- A. Transformers shall meet the quality requirements of NEMA Standard ST20, Transformers - Dry Type and applicable ANSI, UL and IEEE Standards.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The quality of transformers shall be approved equal to the products of the following manufacturers: Cutler-Hammer, Siemens, Heavy Duty, Square D, and General Electric Co.

2.2 PRODUCTS

- A. General: Dry type transformers shall be 2 winding type conforming to the applicable requirements of NEMA Standard ST20, Transformers - Dry Type and also to applicable ANSI, UL and IEEE Standards. "T" connected windings will not be acceptable for 3-phase transformers.
 - 1. Transformers rated up to 15 kVA, 3-phase and 25 kVA single phase shall be UL listed for either indoor or outdoor use and shall be of totally enclosed

design with encapsulated coils to protect core and coils against adverse atmospheric conditions.

2. Transformers rated 37.5 kVA to 167 kVA single phase or 30 kVA to 500 kVA 3 phase shall be suitable for indoor use only but shall be resistant to thermal shock and high humidity.

- B. Electrical Rating: Number of phases, frequency, self cooled load rating, high and low voltage and phase connection are indicated on the drawings. A permanent nameplate shall be furnished with each transformer, giving complete data of transformer, including percent impedance, based on self cooled rating and show tap settings.

1. A minimum of 4, full-rated taps shall be provided in high voltage winding, two, 2-1/2 percent below and two, 2-1/2 percent above nominal voltage.

- C. Temperature Classification: The transformer shall utilize an insulation system that has been properly temperature classified and approved by UL. Unless otherwise indicated, the insulation rating shall be as follows:

| <u>kVA Rating</u> | <u>Preferred Insulation System Temperature Classification</u> | <u>Winding Temperature Rise</u> |
|-------------------|---|---------------------------------|
| 5 kVA to 25 kVA | 180 degrees C | 115 degrees C |
| 30 kVA to 500 kVA | 220 degrees C | 150 degrees C |

Winding temperature rise limits applicable to the system temperature classification shall be in accordance with Specification UL 506.

- D. Load Rating:

1. Transformers shall be capable of operating at 100 percent of nameplate rating continuously while in an ambient temperature not exceeding 40 degrees C.
2. Transformers shall be capable of long service life under the thermal conditions specified. There shall be no need for derating.

- E. Sound Rating: The transformer shall have sound levels equal to or lower than those shown below:

| <u>Transformer Rating kVA</u> | <u>Maximum Sound Level Decibels in Accordance with ANSI C89</u> |
|-------------------------------|---|
| 0-9 | 40 |
| 10-50 | 45 |
| 51-150 | 50 |
| 151-300 | 55 |
| 301-500 | 60 |

- F. Other Requirements: The following requirements shall be in accordance with Specification UL 506:

1. Enclosures:
 - a. Ventilation openings.
 - b. Corrosion resistance.
 - c. Cable bending space.
 - d. Grounding provision.
 - e. Surface temperatures.
 - f. Wiring compartment temperature rise.

g. Terminations.

- G. Transformers indicated as K rated type transformers shall, in addition to the listed specifications, have the neutral capable of handling 200 percent of rated secondary phase current. In addition, an electrostatic shield shall be furnished between the primary and secondary windings to attenuate line source interference and undesirable frequencies. Transformer shall meet K13 standard for systems with 100 percent connected nonlinear electronic loads.
- H. Transformers hung from ceiling or wall mounted shall be provided with protective screen over bottom to prevent the entry of foreign objects.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide approved mounting for transformers as shown on the drawings.
- B. Floor-Mounted Transformers:
 - 1. Provide 3-inch concrete mounting pad with beveled edges, 2 inches larger than transformer on each side.
 - 2. Verify position with D.P. for access, service, and location. Transformers shall not be less than 6 inches from nearest wall or ceiling.
 - 3. Transformer installation shall not restrict access to terminal compartments or the flow of air through the transformer vents.
- C. Transformer installations shall contain the following:
 - 1. Flexible metallic conduit connection of adequate length to permit flexing by hand. Maximum length shall not exceed 36 inches without approval from D.P.
 - 2. Neoprene covered flexible conduit where required for water-resistant installations.
 - 3. Proper vibration isolating pads approved equal to Korfund, arranged to prevent 60- and 120-Hz transmission to structure and piping.
- D. The neutral point on all single phase and 3-phase transformers shall be grounded by a continuous grounding conductor sized in compliance with NEC, Table 250-94. Bond ground conductor to transformer case.
- E. Suspended transformers shall be supported with welded channel attached to structural steel of building. When point of support to structural member is not defined on drawings, obtain location of support from D.P.
- F. Wall-Mounted Transformers (where indicated):
 - 1. 30 kVA each maximum, and designed for wall support.
 - 2. Larger than 30 kVA shall be supported as detailed on drawings.

END OF SECTION 26.22.13

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SECTION 26.24.16 - PANEL BOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Refer to Division 26, Section 26.05.01 - ELECTRICAL WORK, GENERAL for general requirements.

1.2 SUMMARY

- A. The work includes furnishing and installing circuit breaker-type panelboards as shown on drawings and specified herein.

1.3 SUBMITTALS

- A. Shop drawings.

1.4 QUALITY ASSURANCE

- A. NEMA Standard PBI-Panelboards and NEC.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide panelboards manufactured by one of the following or approved equal:
 - 1. Eaton / Cutler Hammer
 - 2. General Electric Company.
 - 3. Schneider Electric / Square D.

2.2 PANELBOARDS

- A. Panelboards shall be provided as scheduled. Voltage, bus capacity, phase and frequency shall be as shown. Panelboards shall conform to the requirements of NEMA Standard PBI-Panelboards and bear UL label. Panelboards shall be suitable for use with 75 degrees C wire insulation.
- B. Panelboard Box: Panelboard box shall be fabricated from galvanized sheet steel in accordance with UL's standard for panelboard boxes. A turned edge shall be provided around the front of the box for rigidity and attachment of the front. Box size shall be provided to allow wiring gutters of 4 inches minimum on sides and 6 inches

on ends. Minimum box width shall be 20 inches, unless otherwise indicated. Exterior panels shall be NEMA 3R.

- C. **Panelboard Front:** The panelboard front shall be factory finished and consist of a flat piece of sheet steel, with opening to which the panelboard door is attached by means of semi-concealed hinges. Panel front cover shall be hinged to enclosure so as to provide "hinged door-in-door". The door shall have cylinder tumbler-type lock. On doors more than 48 inches high, a combination three-point catch and lock shall be provided. A circuit directory, neatly typed, shall be provided on the inside of the door. Circuit directory shall be not less than 6 inches wide by 10 inches high mounted behind clear plastic.
- D. **Interior:** Interior shall be of the unit type, mounted on a back plate, properly reinforced by flanging, providing a rigid assembly to protect against damage during handling or installation. Structure shall be so designed that units may be easily removed without disturbing adjacent units, bus structure, or insulation. A removable dead-front shield shall be provided for easy access to the wiring. Panel bussing shall be arranged to maintain sequence phasing, throughout, that is, adjacent poles shall be of unlike polarity and rotated in sequence. All spaces shall be completely bused for breakers.
- E. **Main and Branch Circuit Protective Devices:** Main and branch circuit protective devices shall be molded-case circuit breakers consisting of the number of poles, and ampere rating, as shown on the schedules. Main breakers shall have shunt trip feature where indicated on the drawings.
- F. **Circuit Breakers:** Circuit breakers shall have quick-make and quick-break toggle mechanisms, inverse-time trip characteristics, and shall be trip-free on overload or short circuit. Automatic release shall be secured by a bimetallic thermal element releasing the mechanism latch. In addition, an instantaneous magnetic trip shall be provided for short circuit currents above the overload range. Rated interrupting current for circuit breakers shall be as shown. Automatic tripping shall be indicated by handle position between the manual OFF and ON positions. Circuit breakers shall be single, two, or three pole as noted. Two and three pole breakers shall have one common handle, handle ties will not be acceptable. All breakers shall be the bolt-on type; plug-in breakers not acceptable except Square D "I" Line construction. Provide locking devices on breaker handles where indicated on schedules. Provide ground fault breakers or other special breakers as indicated on the schedules.
- G. **Neutral Bus:** Panelboards designated as three phase, four wire and single phase three wire shall be provided with an insulated neutral bus with numbered points for circuit connections.
- H. **Ground Bus:** Ground bus shall be provided in each panelboard box. Bus shall be used for all protective ground conductor connectors.
- I. Lug sizes shall be compatible with conductor sizes.
- J. Panelboard buses shall be copper.
- K. Panelboards serving electronic loads, fed from k-rated transformers, shall have a neutral bus rated 200 percent of the phase bus capacity. Panels shall be factory labeled "Neutral Rated at 200 percent". Panelboard shall be UL listed for nonlinear loads.

- L. Panelboards serving electronic loads, fed from k-rated transformers, shall have both a standard ground bus and an isolated/insulated ground bus.
- M. Manufacturer shall arrange breakers in each panelboard to match breaker arrangement shown on the drawings for the respective panelboard schedule.
- N. Panelboards shall be fully rated for the short circuit interrupting rating shown on the panelboard schedules on the drawings. Use of a series connected rating is not acceptable.
- O. All circuit breakers, regardless of current rating, shall be marked as suitable for use with 75 degrees C wire insulation. In addition, the panelboard shall also be marked suitable for use with 75 degrees C wire insulation.

2.3 SURGE PROTECTORS

- A. Where indicated on the drawings, provide Transient Voltage Surge Suppressor (TVSS) as indicated in Section 26.43.13 - TRANSIENT VOLTAGE SURGE SUPPRESSION SYSTEM.

PART 3 - EXECUTION

3.1 MOUNTING

- A. Panel directory, as a minimum, shall indicate breaker position number, equipment served, room name and number.
- B. All breaker positions shall be numbered.
- C. All breaker trip ratings shall be readable without removing panel front cover.
- D. Exterior panels shall be mounted on supports to prevent trapping of moisture between panel and wall.
- E. Contractor is responsible to coordinate panel installations with ALL trades to ensure NEC "working clearances" are not violated.
- F. Branch breakers and loads served shall be arranged in each panelboard to match breaker arrangement shown on the drawings for the respective panelboard schedule. Circuiting to building loads shall match panelboard schedules shown on the drawings.

END OF SECTION 26 24 16

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**SECTION 26.27.26 – WIRING
DEVICES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Receptacles.
 - 2. Switches.
 - 3. Wall plates.
 - 4. Plugs.
 - 5. Connectors.
- B. Special devices, as noted.

1.2 SUBMITTALS

- A. Shop Drawings: Catalog sheets of required devices.
- B. Samples: Upon request.

1.3 QUALITY ASSURANCE

- A. Qualification:
 - 1. Wiring devices meeting the below listed standards, as manufactured by firms named hereinafter for specific devices and within the classes required, shall be provided.
- B. Certifications:
 - 1. Wiring devices shall meet NEMA Standard WD-1, Wiring Devices, premium specification grade for heavy duty devices. Special purpose receptacles shall conform to the requirements of NEMA Standard WD-5, Wiring Devices, Specific Purpose. Wiring devices shall bear UL labels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: The following are approved for the specific device as listed:
 - 1. Arrow-Hart.
 - 2. General Electric.
 - 3. Hubbell.
 - 4. Leviton.
 - 5. Pass & Seymour.
 - 6. Slater.
- B. Other Manufacturers:

1. Other manufacturer's devices may be submitted for approved by submitting full technical information and samples. Merely submitting catalog cut sheets will not be acceptable.

2.2 MANUFACTURED UNITS

A. General:

1. Provide factory-packaged wiring devices, in type, color and electrical rating for the service required and as indicated hereinafter. Where type and grade are not indicated, provide proper selection as required by the equipment to be served to fulfill the wiring requirements, and to comply with NEC and NEMA standards for wiring devices.

B. Colors:

1. Colors of devices for general use shall be as indicated for respective devices or as designated by the Architect-Engineer for specific areas.

2.3 EQUIPMENT

A. Switches, General Purpose:

1. Switches shall be heavy duty AC rated 20 amperes, 120/277 volts red face, and shall be single-pole, double-pole, three- and four-way as required for the specific switching arrangements in each space.
2. Switches shall be as specified below by designated manufacturers:
 - a. Switches, standard:

| <u>Manufacturer</u> | <u>Catalog No.</u> |
|---------------------|--------------------|
| Hubbell | CS-20-I or equal |
| Arrow-Hart | CS-20-I or equal |
| Pass & Seymour | CS-20-I or equal |
| Slater | CS-20-I or equal |
| General Electric | CS-20-I or equal |
| Leviton | CS-20-I or equal |

- 1) Switches shall be ivory in color, except as indicated otherwise.

B. Receptacles, Standard Duplex:

1. Receptacles shall be three-wire auto grounding type, 120 volt, side and back wired.
2. Receptacles for general service shall be as specified below by designated manufacturers:
 - a. 20A duplex receptacles:

| <u>Manufacturer</u> | <u>Catalog No.</u> |
|---------------------|--------------------|
| Hubbel | CR20-I or equal |
| Slater | CR20-I or equal |
| Pass & Seymour | CR20-I or equal |
| Leviton | CR20-I or equal |
| General Electric | CR20-I or equal |

- b. Equivalent approved devices by other manufacturers will be acceptable.
- c. Receptacles shall be ivory in color unless otherwise noted.

C. Corrosion Weatherproof Resistant Devices:

1. Shall be similar and approved equal to items specified for normal usages, except fabricated of yellow color melamine plastic.
- D. Miscellaneous Devices:
1. Special purpose receptacles for specific equipment shall conform to the requirements of NEMA Standard WD-5, Wiring Devices, Specific Purpose, and shall be of the NEMA style number shown or manufacturer's number indicated. Provide a matching cap for each special purpose outlet supplied, each cap being equipped with a cord grip. Special purpose outlets shall be manufacturer's standard color.
 2. Special Use Devices:
 - a. Interior Receptacle with Ground Fault Protective Device: 20A circuit, approved equal to P&S No. 1591-F1D.
 - b. Lockable Exterior Receptacles with Remote G.F. Breaker shall be installed with TayMac Corp., tumbler lock, device cover.
- E. Shunt Trip Station:
1. Provide complete station with hammer, backbox and stainless steel face plate. Station shall be push to trip type.
 2. Unit shall be mounted as indicated on the drawings with the appropriate type of backbox, flush mount station in NEMA 1 with weathertite face plate box unless otherwise indicated.
 3. Engrave faceplate as follows: "ELECTRIC DISCONNECT, BREAK GLASS, PUSH BUTTON."
 4. Unit shall be Pilla Electrical Products or equal.
- F. Device Plates:
1. Plates shall be provided for all wiring devices and telephone or systems outlet boxes. Plates shall be of suitable configuration for the number and type of devices for which it is intended.
 2. Materials and colors of device plates, unless otherwise noted, shall be as follows:

| <u>Location</u> | <u>Type</u> |
|----------------------------|---|
| Interior Devices-general | Commercial specifications grade, plastic, ivory color. |
| Interior Devices - special | Provide stainless steel cover plate in the utility corridors, loading dock, maintenance and other similar areas subject to rough usage. |
| Exterior Outlets | Cover plates shall be TayMac Corp. recessed masque with tumble-type lock to fit the number and type of devices installed. Surface-mounted outlet covers may be used where approved by the Architect-Engineer. UL listed for wet location use per NEC Article 410-57(b). |

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Surface Preparation:

1. Wiring devices shall not be installed in exposed masonry until cleaning of masonry with acids has been completed.

3.2 INSTALLATION

A. Devices and Covers:

1. All standard receptacles shall be grounded by means of a ground wire. Strap alone will not constitute an acceptable ground.
2. Devices and cover plates shall be securely installed, with cover plates in true vertical or horizontal alignment, as applicable. Plates shall properly contact surfaces to which attached.

3.3 CLEANING

A. Devices and Covers:

1. All devices and cover plates shall be free from paint, sheet rock mud, mortar, etc. upon completion of project.
2. Devices and covers that have any construction materials on them or devices or covers which have been damaged in the cleaning process shall be replaced.
3. Devices found with glue residue from tapping shall be replaced.

END OF SECTION 26.27.26

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**SECTION 26.28.16 – SAFETY
SWITCHES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Refer to Division 26, Section 26.05.01 - ELECTRICAL WORK, GENERAL for general requirements.

1.2 SUMMARY

- A. Section Includes: The work includes providing safety switches as indicated or required.

1.3 SUBMITTALS

- A. Shop Drawings: Showing fuses, number of poles, enclosures and ratings.

1.4 QUALITY ASSURANCE

- A. Compatibility: Insure that ratings of installed switch and motor are compatible when switch is serving as motor-disconnect.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following, or an approved equal:
 - 1. Switches:
 - a. Cutler Hammer.
 - b. General Electric.
 - c. Siemens.
 - d. Square D.
 - 2. Fuses:
 - a. Bussman.
 - b. General Electric.
 - c. Gould Shawmut.

2.2 MATERIALS

- A. Safety switches shall be NEMA heavy duty, fused or nonfused, of rating and number of poles as indicated or required.

- B. Safety switches shall be provided with rejection fuse clips where current limiting fuses are specified.
- C. Interior enclosures shall be NEMA 1, except as otherwise indicated. Exterior shall be NEMA 4X, except as otherwise indicated.
- D. Doors to safety switches shall interlock so that cover cannot be opened when switch is closed but shall be provided with a defeat mechanism to allow authorized personnel to open enclosure without opening switch.
- E. Switches shall be quick-make, quick-break type, constructed so switch blades are visible in "OFF" position with door open, equipped with operating handle which is an integral part of the enclosure base and whose position is easily recognizable and is padlockable in the "OFF" position. Current carrying parts shall be constructed of high-conductivity copper, and silver-tungsten type switch contacts with positive pressure type reinforced fuse clips in fusible switches.
- F. Provide fuses for fusible switches, of class, type and rating as follows:
 - 1. General: Fuses shall be rated for the voltage indicated on the drawings and shall be rated for the continuous current indicated.
 - 2. Motor Application: Dual element type, selected in accordance with the applicable requirements of Articles 430 and 440 of the NEC. Fuses shall include rejection slots, UL class RK5. Characteristics shall be essentially equivalent to Shawmut A Amp Trap Dual Element with Time Delay, Class RK5.
 - 3. Other Applications: Unless otherwise indicated, fuses selected for all applications other than for use with motors shall be current limiting types, dual element with time delay, UL class ARK1" rated 600 volts. Current limitation shall be essentially equivalent to Shawmut A Amp Trap@ Class RK1.
 - 4. Interrupting Ratings: All fuses shall be rated to interrupt 200,000 RMS symmetrical amperes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Switches shall be plumb and securely mounted.
- B. Install safety switches in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices to ensure that products serve the intended function.
- C. Install disconnect switches used with motor-driven appliances, and motors within sight of the motor position unless otherwise indicated.
- D. Exterior switches shall be mounted on supports to prevent trapping of moisture.

END OF SECTION 26.28.16

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**SECTION 26.29.13 – INDIVIDUALLY
MOUNTED MOTOR CONTROLLER**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Refer to Division 26, Section 26.05.01 - ELECTRICAL WORK, GENERAL for general requirements.

1.2 SUMMARY

- A. Unless otherwise indicated, every motor or piece of equipment not specified to be provided with a controller at the factory shall be provided with a controller as specified herein.

1.3 SUBMITTALS

- A. The following shop drawings shall be submitted to show:
 - 1. General layout.
 - 2. Elementary wiring diagrams of standard motor controllers by size.
 - 3. Outline and wiring diagrams of all special devices.

1.4 QUALITY ASSURANCE

- A. NEMA Standard IC-1 Industrial Control, other applicable standards of NEMA, and applicable standards of IEEE, ANSI, NEC and National Electrical Safety Code.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Motor controllers shall conform to the applicable requirements of NEMA S Standard IC-1 Industrial Control. Controller sizes shall be verified to be compatible with horsepower of the motor.

2.2 MANUAL MOTOR STARTERS

- A. Switches shall be tumbler-switch style. The manual motor starters shall provide overload protection which closely follows the motor load. Manual motor starters shall be in the following enclosures unless otherwise noted.
 - 1. For outdoor installation - NEMA Type 4X Rainproof.
 - 2. For indoor installation - NEMA Type 1, General Purpose.

2.3 MAGNETIC ONLY MOTOR CONTROLLERS

- A. Nonreversing Magnetic Controllers: Nonreversing magnetic controllers shall start full voltage, nonreversing, AC single speed motors. The controllers shall be sized for the load unless otherwise indicated.
- B. Control transformers shall be provided. Both legs of the primary and one leg of the secondary of the control transformer shall be protected by NEMA Class J fuses. The other leg of the secondary shall be grounded. The capacity of the control transformers shall be adequate to operate all the control devices in the circuit.
- C. Overload Relays: Bimetallic relays are preferred. Overload relays shall be supplied in each leg. Overload relays shall be matched to load and shall be adjustable from 90 percent to 110 percent. A single reset button shall be mounted on the starter door to permit external reset. The relay shall be convertible from manual to automatic reset by a simple adjustment.
- D. Where multispeed motors are scheduled on the drawings, the motor controls shall be compatible with the type motor shown.
- E. Reduced Voltage, Auto-Transformer Type: Reduced voltage controllers shall be provided for all motors rated above 40 HP at 480 volts. The controllers shall be of the closed transition type, with definite time transfer from start to run. Taps shall be provided at 50 percent, 65 percent, and 80 percent of line voltage. Contactors shall be mechanically and electrically interlocked.
- F. In size 3 & 4 reduced voltage nonreversing and Size 5 & 6 starters the contactor coil shall be operated at line voltage. The starters shall be operated by a control relay with 120 volt coil. Two NEMA Class J fuses shall be provided connected from line to starter coil circuit.
- G. Unless otherwise indicated, all motor starters shall be provided with hand-off-automatic (HOA) switch in the door.
- H. Auxiliary Contacts: Motor controllers shall be provided with all control devices including auxiliary contacts for equipment to operate as specified.
- I. Controllers shall be in the following enclosures unless otherwise noted:
 - 1. For indoor installation - NEMA Type 1, General Purpose.
 - 2. For outdoor installation - NEMA Type 4X, Rainproof.
- J. Provide phase loss protection for motors 3 HP and larger.
- K. Provide red running light indication on the controller.

2.4 COMBINATION MOTOR CONTROLLERS

- A. Combination motor controllers shall be provided with "Mag-Break" motor circuit protective device unless noted otherwise. Motor circuit protective device shall have 25,000 symmetrical RMS amperes short-circuit rating unless indicated otherwise. Unit control circuit fusing shall be provided. The motor circuit protective device shall be mounted in the same enclosure as the magnetic controller and shall be operable by hand from outside the enclosure. The handle shall be so interlocked with the door that it must be returned to the "OFF" position before the door can be opened,

but a defeat mechanism shall be provided to allow authorized personnel to open the enclosure door without opening the disconnecting device. Provision for padlocking the disconnect handle in the "OFF" position shall be made.

- B. Motor circuit protectors shall be the continuously adjustable, instantaneous magnetic trip type circuit breaker and shall be so constructed that all poles open, close and trip simultaneously. The continuous current rating of the motor circuit protector and the minimum fault-current, interrupting capability of the combination motor controller and motor circuit protector, shall be as indicated on the drawings.

2.5 OVERLOAD PROTECTION

- A. Heater elements shall be provided for overload protection.

PART 3 - EXECUTION

3.1 SETTINGS, OVERLOAD AND SHORT CIRCUIT PROTECTION

- A. Establish heater element size and establish and set the instantaneous trip point of the motor circuit protector, if used, based upon the nameplate data of equipment actually supplied and in accordance with the NEC.

3.2 INSTALLATION

- A. Coordinate vertical and horizontal clearances with adjacent equipment.

END OF SECTION 26.29.13

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**SECTION 26.33.33 –
UNINTERRUPTIBLE POWER SUPPLY**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provision of the contract, including general and supplementary conditions and Division 1 specification sections apply to the work of this section.
- B. Section 28.13.19 Computerized Controlled Access System (CCAS).
Section 27.11.16 Communications Room Fittings.
Section 27.21.29 Network Equipment.

1.2 SUMMARY

- A. The uninterruptible power supply shall provide continuous high quality regulated sine wave power to the digital control system upon loss of normal power.

1.3 SUBMITTALS

- A. Submittals Package: Submit the shop drawings, product data, and quality control submittals specified below at the same time as a package.
- B. Shop Drawings:
 - 1. Wiring and / or schematic diagram of the complete system as proposed to be installed (typical diagrams will not be accepted).
- C. Product Data:
 - 1. Catalog sheets, specifications and installation instructions.
 - 2. Company's data indicating volt-amp rating with proof that the unit will meet the final system test.
 - 3. Name, address and telephone number of nearest fully equipped service organization.
- D. Quality Control Submittals:
 - 1. Battery Purchase Data: Statement indicating proposed date for battery purchase and installation.
 - 2. Company Field Advisor Data: Include:
 - a. Name, business address and telephone number of Company Field Advisor secured for the required services.
 - b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
 - c. Services and each product for which authorization is given by the Company, listed specifically for this project.
- E. Contract Closeout Submittals:
 - 1. Test Report: System acceptance test report.

2. Certificate: Affidavit, signed by the Company Field Advisor and notarized, certifying that the system meets the contract requirements and is operating properly.
3. Battery Manufacture Certified Date: Upon battery purchase, submit certified data from the battery manufacturer indicating date batteries were manufactured.
4. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Owner.

1.4 QUALITY ASSURANCE

- A. Source Quality Control: The company producing the system shall have test facilities available which can demonstrate that the proposed system meets contract requirements.
 1. If brand names other than those specified are proposed for use, pay all costs, including travel expenses to the test facility for the Owner's Representative to witness test demonstration.
- B. List of Completed Installations: If brand names other than those specified are proposed for use, furnish the name, address, and telephone number of at least 5 comparable installations which can prove the proposed products have operated satisfactorily for three (3) years.
- C. Company Field Advisor: Secure the services of a Company Field Advisor for a minimum of twenty-four (24) working hours for the following:
 1. Render advice regarding installation and final adjustment of the system.
 2. Verify that batteries are properly matched to units.
 3. Witness final system test and then certify with a sworn affidavit that the system is installed in accordance with the contract documents and is operating properly.
 4. Train facility personnel on the operation and maintenance of the system (minimum of two 4 hour sessions).
 5. Explain available service programs to facility supervisory personnel for their consideration.
- D. Service Availability: A fully equipped service organization capable of guaranteeing response time within twenty-four (24) hours to service calls shall be available to service the completed Work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Purchase batteries within sixty (60) days of final system test.
- B. Batteries shall not have been in an active state prior to purchase. Shelf life shall not exceed battery manufacturer's recommendations.

1.6 PROJECT CONDITIONS

- A. The uninterruptible power supply shall meet all requirements at the following ambient temperatures (actual site conditions)

1.7 MAINTENANCE

- A. Spare Parts:
1. Set of cell numbers for mounting on rack.
 2. Anti -corrosion compound for battery connections.
 3. 50 percent spare of each type fuse.

PART 2 - PRODUCTS

2.1 UNINTERRUPTIBLE POWER SUPPLY

- A. The UPS shall be APC Symmetra 4 KVA, N + 1 Rack Mount, 208v input, 120v and 208v output. Provide modules as indicated on Drawing T5-01 or approved equal.
- B.
- | | |
|----------------------------------|--|
| Output | |
| Output Power Capacity | 2800 Watts / 4000 VA |
| Max Configurable Power | 4200 Watts / 6000 VA |
| Nominal Output Voltage | 120V, 208V |
| Output Voltage Note | Configurable for 120/208 or 120/240 output voltage |
| Efficiency at Full Load | 85.00% |
| Output Voltage Distortion | Less than 5% at full load |
| Output Frequency (sync to mains) | 47 - 63 Hz |
| Crest Factor | up to 5: 1 |
| Wave form Type | Sine wave |
| Output Connections | (4) NEMA L5-20R (2)NEMAL6-20R |
- C.
- | | |
|---|---|
| Input | |
| Bypass | Internal Bypass (Automatic and Manual), |
| Optional | External Bypass |
| Nominal Input Voltage | 208V |
| Input Frequency | 45 - 65 Hz (auto sensing) |
| Input Connections | Hard Wire 3-wire (2PH+G) NEMA I6-30P (30 A Twist-Lock) |
| Input voltage range for main Operations | 155-276. |
- D.
- | | |
|---------------------|---|
| Batteries & Runtime | |
| Battery Type | Maintenance-free sealed Lead-Acid battery with suspended electrolyte: leakproof |
| Battery Modules | 4 |
| RunTime: | 1 hour at full load. |
- E.
- | | |
|-----------------------------|------------------------------|
| Environmental | |
| Operating Environment | 32 – 104°F (0 - 40°C) |
| Operating Relative Humidity | 0 - 95% |
| Operating Elevation | 0-10000 feet (0-3000 meters) |
| Storage Temperature | 5 - 113°F (- 15 - 45°C) |
| Storage Relative Humidity | 0 - 95% |
| Storage Elevation | 0-15000 feet (0-4500 meters) |

| | | |
|----|--|---|
| | Audible noise at 1 meter from surface of unit | 62 dBA |
| | Online Thermal Dissipation | 3707.00 BTU/hr |
| F. | Conformance | |
| | Regulatory Approvals | CSA, FCC Part 15 Class A, UL 1778 |
| | Standard Warranty | 2 years repair or replace |
| | Included Battery Modules | 1 |
| | Available Battery Slots | 1 |
| | Typical recharge time | 3 hour(s) |
| | Replacement battery Cartridge | SYBT5 |
| | Typical Backup Time at Half Load | 16.9 minutes (1600 Watts) |
| | Typical Backup Time at Full Load | 5.9 minutes (3200 Watts) |
| | Runtime Chart | Symmetra LX |
| | Extended Run Options | APC Symmetra LX 4kVA Scalable to 6kVA N+ 1 Rack-mount, 208/240V Input, 208/240V and 120V Output |
| G. | Communications & Management | |
| | 1. Interface Port(s) | DB-9-RS-232, RJ45 10 Base-T Ethernet for web/SNMP/Telnet management. |
| | Available Smartslot™ Interface Quantity | 1 |
| | Pre-Installed SmartSlot™ Cards | AP9619 |
| | Control panel | Multi -function LCD status and control console |
| | Audible Alarm | Audible and visible alarms prioritized by severity |
| | Emergency Power OFF (EPO) | Yes |
| | 2. Provide alarm interface with access controls system for remote indication for an alarm. | |
| | 3. Provide network interface with SmartSlot to manage UPS and alarms as well as facilitate orderly shutdown of critical equipment using SNMP Server. | |
| H. | Physical | |
| | Maximum Height | 17.50 inches (445 mm) |
| | Maximum Width | 19 inches (483 mm) |
| | Maximum Depth | 28.75 inches (688 mm) |
| | Rack Height | 10U |
| | Net Weight | 324.00 lbs. (147.27 kg) |

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install uninterruptible power supply complete and ready for service.
- B. Identification:
 - 1. Stencil on front of unit with white paint in one (1) inch high lettering "UNINTERRUPTIBLE POWER SUPPLY".
 - 2. Label function of each branch circuit.

3.2 FIELD QUALITY CONTROL

- A. Preliminary System Test:
 - 1. Preparation: Have the Company Field Advisor adjust the completed system and then operate it long enough to assure that it is performing properly.
 - 2. Run a preliminary test for the purpose of:
 - a. Determining whether the system is in a suitable condition to conduct an acceptance test.
 - b. Checking and adjusting equipment.
 - c. Training facility personnel.
- B. System Acceptance Test:
 - 1. Preparation: Notify the Owner's Representative at least three working days prior to the test so arrangements can be made to have a Facility Representative witness the test.
 - 2. Make the following tests:
 - a. Simulated utility power failure at full load to prove an interruption of load power supply.
 - b. Simulated UPS failure at full load to prove transfer to utility power upon malfunction of UPS (disconnect batteries with temporary disconnect switch or other methods to temporarily disable unit).
 - c. Full load test for 30 minutes to prove capacity of system (utility power source disconnected). Record battery voltage and current at start and end of period. Record AC output voltage at start and end of period. Battery cell voltage under full load at the end of 30 minutes shall not be less than 1.75V.
 - d. Continue at full load beyond 30 minute period to automatic shutdown of inverter due to low battery voltage. Record battery voltage at shutdown and time interval beyond the 30 minute period to shutdown.
 - e. Recharge utility power source, recharge batteries and record time interval required to restore unit to full charge.
 - f. Connect unit to digital control system and flame safeguard systems and simulate utility power failure to prove compatibility of UPS with the connected systems.
 - 3. Supply an adjustable resistive load bank or other approved apparatus to load UPS to full rated load.
 - 4. Supply all equipment necessary for system adjustment and testing.
 - 5. Submit written report of test results signed by Company Field Advisor and the Owner's Representative. Mount a copy of the final report in a plexiglass enclosed frame assembly adjacent to the UPS.

END OF SECTION 26.33.33

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**SECTION 26.41.13 – LIGHTNING
PROTECTION SYSTEM**

PART 1 - GENERAL

1.1 SUMMARY

- A. The work includes providing a functional and UNOBTRUSIVE lightning protection UL Master Label system as specified herein.
- B. If any departure from the submittal drawings covered below are deemed necessary by the Contractor, details of such departures and reasons therefore shall be submitted as soon as practicable to the Architect-Engineer for approval. No such departures shall be made without prior written approval of the Architect-Engineer.

1.2 SUBMITTALS

- A. Shop Drawings: Submit the type, size, and locations of all equipment, grounds, and cable routing on a set of drawings prepared by the Contractor to the same scale as the contract drawings.
- B. Manufacturer's product data.
- C. Samples: Submit a complete selection where requested.
- D. UL Master Label application form.

1.3 QUALITY ASSURANCE

- A. The lightning protection system shall conform to the following requirements:
 - 1. Underwriter's Laboratories (UL) Master Label Code 96A.
 - 2. National Fire Protection Association (NFPA) Code NO. 780.
- B. The lightning protection system shall conform to the requirements of UL, Standards for Lightning Protection Systems. UL Master Label shall be furnished affixed as directed.
- C. The system shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and equipment and shall be the manufacturer's latest approved design.
- D. System manufacturer shall be UL listed and approved manufacturer.
- E. Materials shall be manufactured by Thompson Lightning Protection, Inc., 901 Sibley Highway, St. Paul, Minnesota, 55118, or approved equal.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All material and equipment shall be UL approved and labeled.
- B. All equipment shall be the product of a single manufacturer and of a design and construction to suit the application for which it is to be used, in accordance with accepted industry standards, NFPA and UL Code requirements.
- C. The products of the Thompson Co. are specified to indicate the type and quality required. Equal products of other manufacturers are acceptable only if approved by the shop drawing process.

2.2 EQUIPMENT

- A. Conductors shall be copper for down conductors and aluminum for roof loop conductors for use in structures as recommended by manufacturer.
- B. Conductors: Copper - 29 strands, 17 gauge, as manufactured by Thompson, No. 29X. Aluminum - 24 strands, 14 gauge, Thompson No. A24.
- C. Air Terminals: Solid, round copper bar, 1/2 inch minimum diameter, Thompson Co. or equal. Shall project 10 inches minimum above the object to be protected.
- D. Air Terminal Bases: Cast bronze with bolt pressure cable connections securely mounted with stainless steel screws or bolts. Thompson Nos. No. A680, A678, 78, 611, as required. Bases on built-up or single ply gravel roofing shall be secured with the proper adhesive and shall have a minimum surface contact area of 18.5 square inches, Thompson Cat. No. A688.
- E. Ground Rods: Minimum of 5/8 inches in diameter and 10 feet long, Thompson Cat. No. 225. Connect to system with a 2-bolt cast stainless bronze clamp, Thompson Cat No. 231, having a minimum length of 1-1/2 inches and using stainless steel cap screws.
- F. Cable Fasteners: Electrolytically compatible with conductor and mounting surface, Thompson No. A730, and 166, as required.
- G. Bonding Devices, Cable Splicers and Miscellaneous Connectors: Cast bronze with bolt pressure connections to cable. Cast or stamped crimp fittings are not acceptable. Splicers shall be similar to Thompson Nos. A423B, A705, and A706, as required, Bonding devices similar to Thompson Cat. No. A702 as required.
- H. Miscellaneous Bolts, Nuts and Screws: Brass, bronze, or stainless steel.
- I. Copper to aluminum connectors shall be via or approved bimetallic connector, Thompson 709M.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be accomplished by an experienced installer employed by the approved manufacturer.
- B. All equipment shall be installed in the most inconspicuous manner possible. System shall be installed complete with cable network on the roof, air terminals, splices, and

bonds with cable downleads routed concealed directly in the building construction or in conduit to ground.

- C. Downlead cables shall not be brought directly through the roof. Connectors with solid rods or conduit through pitch pockets shall be used for through roof connector. Downlead conductors shall be installed in PVC conduit concealed in building construction, or building steel may be used for down leads.
- D. Equipment shall not be connected to aluminum surfaces except by a UL approved fitting.
- E. Air terminals and cable fasteners shall be located and spaced in compliance with UL requirements unless shown on drawings.
- F. All connections to building steel shall be inconspicuous and shall be by approved means.

3.2 COORDINATION

- A. Coordinate lightning protection work to ensure a correct, neat, and unobtrusive installation.
- B. Provide a tight, mechanical sound bond to the main water service to assure inter-connecting with other building ground systems, including both telephone and electrical.
- C. Verify that proper arrestors have been installed on the power service.

3.3 LABEL

- A. Secure and deliver a UL Master label to the Architect-Engineer.

END OF SECTION 26.41.13

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**SECTION 26.43.13 – TRANSIENT
VOLTAGE SURGE SUPPRESSION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Refer to Division 26, Section 26.05.01 - ELECTRICAL WORK, GENERAL for general requirements.
- C. Refer to Division 26, Section 26.24.13 – SWITCHBOARDS and Section 26.24.16 - PANELBOARDS for installation of surge protection device in switchboard.

1.2 SUMMARY

- A. These specifications describe requirements for an integrated UL Listed TVSS System. Note that particular care must be taken to install the system as described in the Execution Section of this specification to ensure maximum performance.

1.3 DESIGN REQUIREMENTS

- A. The TVSS system shall be by Advance Protection Technologies, GE, SQD, Siemens, Cuttler-Hammer LEA, Libert, Wiremold, United Power or Leviton and shall be designed, manufactured, tested and installed in compliance with:
 - 1. ANSI/IEEE C62.41 & C62.45
 - 2. FIPS PUB 94
 - 3. NEMA
 - 4. NFPA 70.
 - 5. MIL-STD 220A
 - 6. UL 1449. Systems not UL 1449 Listed are not acceptable.
- B. The ANSI/IEEE C62.41 Category C3 waveform is a 20 kV, 1.2 x 50 microsecond and 10 kAmp 8 x 20 microsecond waveform. All systems provided per this section shall be from the same manufacturer. The system shall not utilize encapsulated components.

1.4 SUBMITTALS

- A. Submittals shall include documentation of:
 - 1. UL 1449 Listing and UL 1449 clamping voltage rating.
 - 2. ANSI/IEEE C62.41 & C62.45 Category C3 clamping voltage.
 - 3. Sequential surge survivability per ANSI/IEEE C62.45.
 - 4. Confirmation of L-G, L-N & N-G mode where specified.
 - 5. Description of internal circuitry and components.
 - 6. Dimensions and weights.
 - 7. Warranty Statement.

8. Recommended connection wiring diagram.
 9. Certification that manufacturer has been manufacturing TVSS systems for a minimum of 5 years.
- B. Submittals shall include a copy of these specifications with each section marked with either "C" for comply or "D" for deviation. A written explanation shall be provided for each deviation for the system to be considered for acceptance. Any deviation may result in the system being determined "Not Acceptable".

1.5 SCHEDULE

- A. The Main Service Switchboard, and each indicated 208Y/120V Distribution Panel as marked with 'TVSS' on the drawings shall be provided with TVSS. TVSS-1 in main switchboard shall be integral mounted in switchboard.

| <u>TAG</u> | <u>LOCATION</u> | <u>VOLTAGE</u> |
|------------|------------------|----------------|
| TVSS-1 | Main Switchboard | 480Y/277 |
| TVSS-2 | Panels | 208Y/120 |

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE - THREE PHASE

- A. Modes of Protection: L-L, L-N & N-G
1. Surge Capacity per Phase: 125,000 Amps
 2. Survivability of Category C3 Surges: 1000 sequential occurrences
 3. Maximum UL1449 Rating, each phase mode: 500 @ 120/240, 120/208; 800 @ 277/480; 1500 @ 480
 4. Category C3 Performance: 552 @ 120/240, 120/208; 940 @ 277/480
 5. EMI/RFI Noise Rejection: 50 dB Common Mode, 40 dB Normal Mode
 6. Connection Method: Parallel
 7. Design Requirements: System shall be composed of a minimum of seven internal modules which may be replaced without replacing the entire unit.
 8. Fused Disconnect: System shall include an internal fused disconnect switch with replaceable 60 amp, 200 kAIC, Class
 9. J fuses or provide circuit breaker in the panel to isolate TVSS.
 10. Monitoring: Redundant illuminated LED on each internal module and additional enclosure mounted LEDs duplicating each internal module's status. LEDs to extinguish when protection fails. Audible alarm, enclosure mounted surge counter and a set of dry NO & NC alarm contacts shall be provided.
 11. Warranty: Five years with unlimited replacement during warranty.

2.2 DISTRIBUTION PANELS

- A. Modes of Protection: L-L, L-N & N-G
1. Surge Capacity per Phase: 50,000 Amps for three-phase panels
 2. Survivability of Category B3 Surges: 1,000 sequential occurrences
 3. Maximum UL 1449 Rating, each phase mode: 500 @ 120/240, 120/208
 4. Category B Performance: 600 @ 120/240, 120/208
 5. Connection Method: Parallel, Provide Factory 24-inch Lead
 6. Connection Length to be Field Trimmed

7. Monitoring: Illuminated LED for each Phase Displaying Normal Protection Existing Operation. LEDs to extinguish when protection fails.
8. Warranty: Five years with unlimited replacement during warranty.

2.3 PROTECTIVE CIRCUITRY

- A. The TVSS shall be designed utilizing multiple solid state components arranged in a symmetrically balanced circuit where each component is equidistant to the input and output leads, thus evenly distributing surge current and reducing stress on individual components. Encapsulation of the internal components shall not be acceptable. Each solid state component shall be individually fused.

PART 3 - EXECUTION

3.1 TERMINATION POINT

- A. Service Entrance systems shall be installed to provide termination as close as possible to the load side of the main disconnect. Panel systems shall be connected to a breaker / non-fused disconnect as close to the main lugs/main breaker as possible.

3.2 INSTALLATION - SERVICE ENTRANCE UNITS

- A. Input connections shall be made for each phase, the neutral and safety ground with #6 AWG conductors. An additional #2 conductor shall be connected between the TVSS surge ground terminal and earth ground directly beneath the TVSS. Non-ferrous conduit shall be used. Conduit shall be separated by a minimum of 4 inches from other conduits and conductors to minimize potential reintroduction of induced transients. A separate surge ground rod shall be provided by the installing contractor. The surge ground rod shall also be bonded to the main electrical system ground system. If the surge ground driven directly beneath the TVSS panel would be within 10 feet of the building electrical system ground, the surge ground may be deleted and the #2 conductor shall connect to the building electrical system ground rod directly. Conductors shall be run as straight and short as possible.

3.3 INSPECTION / TRAINING

- A. Manufacturer's representative shall inspect the TVSS installation and provide dated documentation certifying the installation has been inspected and is installed properly. The manufacturer's representative shall provide instructional training on system operation to the owner.

END OF SECTION 26.43.13

**NEW PARKING STRUCTURE AND
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**SECTION 26.51.10 – LIGHTING
FIXTURES**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Refer to Division 26, Section 26.05.01 - ELECTRICAL WORK, GENERAL for general requirements.
- C. Refer to Division 26, Section 26.56.70 – APRON LIGHTING SYSTEM.
- D. Refer to Division 26 Section 26.51.13 – LAMPS.

1.2 SUMMARY

- A. Furnish and install lighting fixtures as indicated and specified, complete with lamps and required ballasts and accessories. Proper supports for lighting fixtures shall be provided.

1.3 JOB CONDITIONS

- A. Verify the compatibility of recessed lighting fixtures with the ceiling in which each fixture is to be located.

1.4 PRODUCT HANDLING

- A. Deliver fixtures sufficiently in advance of installation to prevent delay of work.
- B. Store all materials in a closed building, in original packaging, and protect from damage and the elements.
- C. Decorative elements of fixtures shall be packed by the manufacturer separately from the housing of the fixture, stored at the job site and installed only after completion of plastering, ceiling tile work, painting and general cleanup in area.

1.5 SUBMITTALS

- A. Shop Drawings: Show fixture locations and support details. Materials shall not be purchased until approved. Include copy of ballast warranty for each type of ballast required.
- B. Product Data: Provide lighting fixture brochures in a single, bound and indexed assembly for all lighting fixtures. Incomplete submittals will be returned without processing.

1. Fixture brochures shall contain manufacturer's name and catalog illustration and number, dimensions and details, ballast and diffuser information, metal gages, pretreatment and paint data, UL-ETL approval, and connection details. Provide photometric data for fixture with lamp and ballast specified. Provide sound rating of ballast. Provide information on adjustable fixtures if such type fixture is required. Provide fuse type and size when specified.
 2. Fixture submittal data shall include lamp data with ANSI ordering code. Where no code has been established, the manufacturer's complete descriptive literature shall be provided with fixture data.
 3. When catalog cuts are submitted, each fixture type shall have the manufacturer's name and catalog number in an obvious location. Cut sheet shall also indicate the type of ballast and lamps to be used.
- C. Submit the following fluorescent lamp ballast data when requested:
1. Manufacturer's certified test data.

PART 2 - PRODUCTS

2.1 GENERAL FIXTURE REQUIREMENTS

- A. Labels: Fixtures shall bear UL and manufacturer's label. Exit fixtures shall be listed to UL924 and comply with NFPA 101, latest edition, visibility standards.
- B. Housings: Constructed of steel, bonderized treated to prevent corrosion and finished with baked white enamel, except where otherwise indicated.
- C. Frame: Furnish necessary "plaster" frames for lighting fixtures recessed in plaster or stucco ceilings and for other non-lay-in installations.
- D. Finish:
 1. All metal parts, except cadmium plated hardware, shall have a five-stage, prepainting hot process similar and equal to bonderizing, applied in accordance with hot bonding process.
 2. Final Painted Enamel Finish: Approved equal to DuPont white having a minimum reflection factor of 85 percent. Final finish shall cover all metal portions and be uniform in color, coverage and gloss. Flat test samples shall withstand 300 hours of salt spray in accordance with ASTM B117.
 3. Porcelain Enamel Finish: Smoothly applied, 90 percent reflectance material and of proper thickness to resist chipping, 0.015-inch maximum.
 4. Aluminizing or Anodizing. Finish process shall be approved equal to Alcoa 202 finish, which shall be 20 minutes minimum in bath, 15 minutes minimum in sealer with final thickness of at least 0.00025 inch.
 5. Duranodic type finishes shall be in accordance with sample approved by D.P.
- E. Ballasts and Fusing:
 1. Electronic Ballasts: Use with all T5 and T8 fluorescent lamps. Provide high frequency electronic ballasts designed to operate 265 ma. programmed start lamps.
 - a. Ballast shall be UL listed Class P with power factor of 0.90 or above and sound levels shall not exceed Class A ambient noise levels.
 - b. Input current total harmonic distortion (THD) content shall be below 10 percent (expressed in percentage of full light output current level).

- c. Ballast shall have a frequency of operation of 20,000 hertz or greater and operate without visible flicker.
 - d. Ballast shall have an average lamp current crest factor of 1.7 or below and shall withstand line transients as defined in ANSI/IEEE C62.41, Category A.
 - e. Ballast case temperature shall not exceed 25 degrees C temperature rise over 40 degrees C ambient.
 - f. Ballast shall operate rapid start lamps connected in series.
 - g. Ballast shall comply with FCC requirements governing electromagnetic and radio frequency interference.
 - h. Ballast Factor (BF) shall be 88 percent or above and ballast shall provide starting sequence consistent with lamp manufacturer's recommendations so as to provide full rated lamp life.
 - i. Ballast shall operate on 120 volts or 277 volts as indicated on the drawings.
 - j. Ballast manufacturer shall have at least 5 years experience manufacturing electronic ballasts with a documentable low failure rate.
 - k. Ballast manufacturer shall warrant ballasts to be free from defects in material or workmanship for at least 3 years from date of manufacture under normal conditions of use.
 - l. Acceptable Manufacturers: Advance; Magnetek TRIAD; and Motorola.
2. Two lamp-type ballasts shall be provided to allow inboard/outboard switching of lamps.
 3. Provide low-temperature starting ballasts of required type for outdoor fixtures and in unheated areas. Starting temperature shall be minus 20 degrees F where available to the trade and 0 degrees F otherwise.
 4. Ballasts for metal halide lamps and high-pressure sodium lamps shall be properly selected for lamp characteristics as indicated on the drawings, operating temperatures and lamp position, where critical. Where available, ballasts shall be HPF. Where proper operation can be secured, ballasts shall be provided which accommodate plus or minus 10 percent input voltage range. Insulation type for ballasts shall be selected by fixture manufacturer for high ambient temperatures in ballast mounting space of fixture. Provide two-winding type ballasts. Starting aid for high- pressure sodium lamps shall be separate from ballast, and encapsulated. Where indicated on drawings, provide ballast with auxiliary winding to operate instant-on quartz lamp. Lamp shall come on instantly on momentary loss of power and remain on until metal halide lamp reaches 40 percent of its full lumen output. Relay for operation of the quartz lamp shall not cause a loss in secondary starting current for H.I.D. lamp. Relay shall be solid state encapsulated designed for operation in 150 degrees F ambient and have a 3-year warranty.
 5. Fixture fusing shall be provided as follows:
 - a. All 277V high-intensity discharge interior fixtures as indicated.
 - b. All exterior lighting for all voltages. Fuses shall be in accessible location, approved equal to Buss and of proper style. Exterior fixture fuses shall be Buss "TRON", or approved equal, in water-resistant enclosure where fixtures may come in contact with moisture or water.
 6. Noisy ballasts shall be replaced, at no additional cost to Owner. Ballasts for indoor application shall be encased in a housing, which provides necessary wiring compartments and provisions for required electrical connectors or devices. Ballast components shall be surrounded with a thermosetting fill to

ensure adequate heat dissipation and quiet operation, below local ambient noise level. Ballasts shall be provided with necessary mounting hardware and vibration dampers. Ballasts for outdoor use shall be encased in weather-tight enclosures with proper outdoor type wiring devices.

- a. Class A sound rating for ballast operating standard fluorescent lamps.
- b. Remote-mounted ballast for operation of metal halid lamps shall be encapsulated for quiet operation.

7. Dimmable Ballast:

- a. Fluorescent ballast shall dim continuously from 100 percent to 5 percent light lumens output. HID dimming ballast shall dim from 100% to 50%.
- b. Ballast shall maintain full filament heat throughout the dimming range for long lamp life.
- c. Ballast dimming circuit shall be UL Class 2 and shall be fully isolated from ballast input power.
- d. For compact fluorescent lamps, ballast shall operate specified four-pin configuration.
- e. Ballast shall be UL listed, Class P, thermally protected, Type 1 outdoor and CSA approved.
- f. Ballast sound levels shall not exceed Class A ambient noise levels.
- g. Input line current total harmonic distortion shall not exceed 10 percent.
- h. Ballast shall have an average maximum lamp current crest factor of not more than 1.5.
- i. Ballast shall have a soft start/rapid start function, which preheats the cathode filaments and then ignites the lamp for maximum lamp life.
- j. Ballast shall withstand line transients as defined in ANSI/IEEE C62.11, Category A.
- k. Ballast shall have a frequency of operation of over 30 kHz and operate without visible lamp flicker.
- l. Ballast shall have a power factor of 95 percent or better.
- m. Ballast shall not contain PCBs.
- n. Ballast shall meet requirements of FCC rules and regulations, Part 18.
- o. Ballast shall have push-in wire connections suitable for 18 AWG solid copper wire.
- p. HID dimming ballast shall incorporate circuitry to start lamp at full power for 15 minutes prior to switching to low power.

F. Sockets:

- 1. Fluorescent Lamp Sockets: "Tombstone" or "butt-on" type for use with bipin lamps shall be provided with plated contacts which depend upon base support only, or contacts of "edge-wipe" style. Lamp insertion channelway of the socket shall be of "D" design. Pigtailed attached to "butt-on" type sockets shall be soldered or welded to contacts. Crimp connections are not acceptable. Leads to "tombstone" type sockets shall be tinned before connection.
- 2. Sockets shall hold lamps securely against normal vibrations and maintenance handling. Provide solid nickel or nickel and silver plated contacts in sockets for the following types of lamps:
 - a. Mogul base - large sizes, incandescent, metal halide, mercury vapor.
 - b. Lamps in all outdoor fixtures.

c. Tungsten halogen lamps.

- G. Adjustable Fixtures: In adjustable fixtures, provide aiming lock devices. Fixtures with adjustable lamps and using lamps with asymmetrical light patterns shall have an aiming stop which can be permanently set so that the lamp shall remain correctly positioned after service or relamping.
- H. Diffusers of Light Fixtures: Each fixture requiring a lens shall be complete with appropriate framed lens 0.125-inch minimum thickness, or as shown on fixture schedule. Florescent fixtures shall have 100 percent virgin acrylic, KSH-12 pattern, or as indicated. For lenses with convex pattern of pyramids or cones, specified minimum thickness refers to distance from flat surface to base of pyramids or cones, or thickness of undisturbed material. For lenses with concave pattern, specified minimum thickness refers to overall thickness of material. Lenses shall essentially eliminate lamp images when viewed from all directions within the 45 degrees to 90 degree angle from the vertical when the ratio of lamp spacing to the distance from lamp underside to top of lens does not exceed 1. Within the viewing angle from zero to 45 degrees the ratio of maximum brightness under a lamp to minimum brightness between lamps shall not exceed 3 to 1.
- I. Parabolic Lens: Parabolic lens shall be shipped to the project site with a factory installed protective self-adhering mylar overlay for protection against construction dust. All parabolic lens shall be free from dust and finger prints prior to Owner acceptance. If necessary, Contractor shall be responsible for cleaning fixture and parabolic lens to remove dust and finger prints.

2.2 LIGHTING FIXTURES

- A. Lighting fixtures shall be provided in accordance with the schedules. Fixtures shall be furnished complete with all accessories necessary for complete and proper installation. Catalog numbers indicated in schedules do not necessarily include plaster frame, special mounting rails and other fittings which may be required for proper installation, but these devices shall be provided where applicable.
- B. Schedule of Fixtures: See drawings.

2.3 EXTERIOR LIGHTING POLES

- A. Provide light poles as specified on the lighting fixture schedule.

PART 3 - EXECUTION

3.1 RECESSED FLUORESCENT FIXTURES

- A. Fixtures shall be installed in suspended ceiling openings as provided. Load bearing supports independent of the suspended ceiling grid, shall be provided along sides and end of fixture.

3.2 LIGHTING FIXTURES RECESSED IN FIRE RATED CEILINGS, AND PLENUM SPACES

- A. Fixture shall be constructed to provide continuous operation when installed in air plenums, or when surrounded with restrictive enclosures.

- B. Where space above ceiling is used as an air plenum changer for either supply or return air the fixture shall be factory wired in accordance with Article 300-22(C) of the NEC.

3.3 WIRING

- A. For 120 volt fixture wiring, use minimum 300 volt, 150C, type SF-1, SF-2, SFF-1, SFF-2, PF or PFF wire beginning at separately mounted outlet box unless higher temperature wire is required by fixture design.
- B. For higher-voltage fixture wiring use 600 volt, Type SF-2 or SFF-2 wire beginning at separately mounted outlet box, unless higher temperature wire is required by fixture design.
- C. All wire nuts used in fixtures shall have helical cone shaped live spring to ensure tight pressure connection. Wire nuts without metal spring are not acceptable.

3.4 BLEMISHED, DAMAGED, OR UNSATISFACTORY FIXTURES

- A. Fixtures shall be replaced with new fixtures.
- B. Fixtures with highly polished reflective surfaces shall NOT be handled with bare hands but with new, clean, grease-free cotton gloves. Surfaces found with finger prints shall be cleaned or replaced with new fixtures.

3.5 TARGETING

- A. Target and adjust fixtures immediately before final inspection.

3.6 CLEANING OF FIXTURES

- A. Before final acceptance of electrical work, clean fixture bottom, trim and reflecting surfaces of dust, dirt, plaster, paint and foreign matter. Mask trim and bottom of all lighting fixtures if necessary to protect the fixtures. Diffuser cleaning materials and methods shall be in accordance with the manufacturer's instructions. As a minimum, fixtures shall be cleaned with a nonstatic producing solution and air dried.

3.7 MISCELLANEOUS REQUIREMENTS

- A. Lighting in equipment rooms and electric closets is diagrammatic, indicating type, quantity and general circuiting of fixtures. Modify locations and mounting to suit conditions, allowing clearances for equipment, piping and ductwork.
- B. Verify recessing depths for all lighting fixtures, and where required, provide matching "modified" units of decreased depth for fixture installation. Verify horizontal clearances and provide units of proper length.
- C. Plaster Frames shall be provided for all recessed fixtures including those located in lath and plaster, gypsum board and similar material.

- D. Light fixtures installed in stair construction shall have clearances verified and coordinated for conduit feeds, concealed conduit systems, recess depths, and other obstructions.
- E. Provide fixture support bars spanning structural T-bar ceiling channels for surface mounting type fixtures. Support bars and fittings shall allow vertical and horizontal positioning of the fixture.
- F. Provide a proper ceiling grid hanger for fixtures that are mounted or suspended from exposed "T-Grid" ceilings. Grid hanger shall be secured to main support channels of the ceiling and shall have provisions for locking in place. Grid hangers shall accept stem canopy or surface fixtures.
- G. Fixtures that are located in acoustical tile ceilings shall be located as indicated on reflected ceiling plans. Fixtures shall be fastened to the ceiling framing member per the requirements on NEC Article 410-16(c).
- H. Fluorescent fixtures in mechanical spaces shall be hung on heavy chain. In areas where exposed ductwork, pipes, and similar obstructions cross locations for light fixture supports, provide Unistrut or approved equal framing supports to span obstruction.
- I. Verify roughing heights of "under-cabinet" type fixture installations to conceal rough-in and provide control by standard wall switch located below fixture and ganged with receptacle where applicable, unless otherwise shown.
- J. EMT shall not be used to support suspended fixtures of any type. Suspension shall be by standard hangers, where available and applicable; by rigid threaded conduit and fittings, or by approved rods.
- K. Where fixtures are to be mounted on, or suspended from, concrete ceilings, cast-in inserts shall be provided. Tamped or drilled inserts will not be acceptable.
- L. Fixtures shall not be supported by outlet box cover screws alone, a fixture stud or "hickey" shall be provided for added support.
- M. Fixtures located in Fire Underwriters rated ceiling shall have an equal fire enclosure around fixture. Enclosure shall contain 10 percent maximum free area in ventilation openings.
- N. Direct embedded exterior lighting poles with 35 feet overall length shall be set to a depth of 5 feet. Pole installation shall comply with manufacturer's suggested installation procedures.

3.8 TESTS

- A. Each support for fixtures shall be tested with a weight of not less than 50 pounds or three times the weight of the installed fixture, whichever is greater.

END OF SECTION 26.51.10

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SECTION 26.51.13 – LAMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide lamps for all lighting fixtures furnished as work of this contract.

1.2 DELIVERY AND STORAGE

- A. Lamps shall be delivered in manufacturer's packing in undamaged condition.
- B. Lamp containers shall be stored where protected from the elements in dry and heated area.
- C. Installation shall not be made until approved by Architect-Engineer. Lamps used during construction shall be replaced with new lamps prior to final inspection.

PART 2 - PRODUCTS

2.1 FLUORESCENT LAMPS

- A. F32T8/3550X: For all new fluorescent fixtures except where specifically indicated otherwise use "OCTRON" T8 rapid start type rated at 32 watts. Minimum rated light output shall be 2,850 lumens. Triphosphors inside lamps shall produce a neutral color spectrum (3,500 K) with 85 CRI or higher. Rated average lamp life shall not be less than 20,000 hours based on 3 hours per start.
- B. F28T5
- C. Compact Fluorescent (CF): Use for down lights and wall washers. Compact twin-tube or quad-tube lamp with color temperature 3,500 K and 10,000-hour lamp life.
- D. Acceptable Manufacturers:
 - 1. General Electric.
 - 2. OSRAM-Sylvania.
 - 3. Phillips.

2.2 INCANDESCENT LAMPS

- A. Incandescent lamps shall be furnished in the style, size and performance characteristics as required or as indicated on drawings for the proper operation of the fixture specified. All lamps shall be energy saving, extended life type, rated for 130 volts.
- B. In certain areas, "under-lamping" may be indicated on the drawings and socket extender shall be provided for proper position of lamp in relation to lamp reflector.

- C. Lamps shall be General Electric Watt Miser Plus or equal.
- D. Where specified fixture design uses reflector type lamps, such type lamp shall be furnished in "spot" or "flood" type as correct for this installation, and shall have same socket arrangement.

2.3 HIGH-PRESSURE SODIUM LAMPS

- A. Provide high-pressure sodium lamps of wattage indicated in Fixture Schedule for use with ballast designed for this lamp, and for correct burning position.

2.4 METAL HALIDE LAMPS

- A. Metal halide lamps shall be 100W to 1500W as scheduled, of identical color rendition, and selected for burning position and enclosure restrictions in accordance with the manufacturer's lamp application data. Ballast design shall be properly selected for each specific lamp application.

2.5 QUARTZLINE LAMPS

- A. Provide type as required by specified fixture design and as shown in Fixture Schedule.

2.6 MANUFACTURERS

- A. Acceptable lamp manufacturers are: General Electric, Phillips and OSRAM-Sylvania.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Section 26.51.10 - LIGHTING FIXTURES.

END OF SECTION 26.51.13

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**SECTION 27.32.01 –
SECURITY TELEPHONES**

PART 1. GENERAL

- 1.1 The Emergency Phone shall consist of a vandal resistant and ADA-compliant hands-free speakerphone communications device with a stainless steel faceplate and metal buttons.
- 1.2 The Emergency Phone shall have one tactile button labeled "EMERGENCY" and one red light emitting diode (LED) labeled "LIGHT ON INDICATES CALL RECEIVED".
- 1.3 Unit shall comply with Part 68 of the FCC rules for the United States.
- 1.4 Contractor shall submit manufacturer's product data and cut sheet.
- 1.5 Equipment shall be warranted against any defects in material and workmanship, under normal use, for a period of twelve months from date of installation. In the event system is found by manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace any defective parts, provided the equipment is returned to manufacturer.

PART 2. PRODUCTS

- 2.1 Approved Manufacturers:
 - A. Talk-A-Phone Model ETP 100MB (Basis of Design)
 - B. Hubbell GAI-Electronics Model 296-297
 - C. Code Blue Model FME
- 2.2 Chassis and face plate shall be constructed of stainless steel with a #4 brushed finish. Push button and switch shall be a single assembly rated for 1,000,000 cycles. Epoxy seals shall protect contacts and terminals from hostile environments and solder flux. Case shall be moisture-proof, dust-tight and designed to accommodate the high shock military specifications of MIL-STD-202, method 207. Case shall be aluminum alloy, anodized clear. Button shall be black anodized aluminum. Unit shall be designed for surface or flush mounting on a wall or in an elevator, as specified on the drawings.
- 2.3 Speaker and microphone shall be protected by non-ferrous metal screen to provide a barrier against vandalism. Signage shall be constructed of cast metal with lettering and Braille raised approximately 3/32" for ADA compliance. Word "EMERGENCY" shall be black
- 2.4 The unit shall be totally hands-free on both sides after connection is initiated at site or by attendant. The unit shall be programmable from a remote telephone via keypad entry. All programming shall be stored in non-volatile EEPROM memory.
- 2.5 Unit shall be programmable with two different telephone numbers of up to 18 digits each including pauses. If first number does not answer or is busy, unit shall automatically call

the second number. If that number is busy or does not answer, unit shall call the first number again. Unit shall continue alternating until call is answered or call timer limit is reached. When call is finished, unit shall automatically shut off.

- 2.6 The unit shall be capable of operating on standard phone lines or analog PBX extensions and shall be phone line powered, requiring no outside power source or battery back-up. DIP switch programming, push to talk devices, and devices requiring external power are not acceptable. The unit shall have a dedicated communication line.
- 2.7 Unit shall be capable of automatically notifying attendant of location via programmable ID.

PART 3. EXECUTION

- 3.1 Install per manufacturer's instructions.
- 3.2 Demonstrate complete system operation to owner and Architect/Engineer.
- 3.3 Provide two hours of training for owner's personnel.

End of Section 27.32.01

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**SECTION 28.31.10 – FIRE ALARM
SYSTEM**

PART 1 - GENERAL

1.1 SCOPE

- A. This specification provides the requirements for addressable analog multiplexed voice notification type networked fire detection system. The system shall include but not be limited to:
 - 1. Control panel.
 - 2. Annunciator Panel
 - 3. Tone alarm.
 - 4. Alarm initiating devices.
 - 5. Alarm notification devices.
 - 6. Conduit and wire.
 - 7. Accessories required for complete certified operating system.
 - 8. Shutdown of air handling units.
 - 9. Interface with building automation (BAS) and building security system.
- B. The contractor shall be responsible for obtaining the required permits and approvals of the local AHJ and shall provide all required modifications at no expense to the owner.
- C. Related work in other sections:
 - 1. Section 14210 - HYDRAULIC ELEVATORS.
 - 2. Section 15325 - STANDPIPE AND SPRINKLER SYSTEMS.
 - 3. Section 15975 - CONTROL SYSTEM EQUIPMENT.
 - 4. Section 15985 - SEQUENCE OF OPERATION.

1.2 REFERENCES AND STANDARDS

- A. The complete equipment and installation of the system shall comply with the latest edition of the following references and standards.
 - 1. NFPA 70 – National Electric Code (NEC).
 - 2. NFPA 72 – National Fire Alarm Code.
 - 3. NFPA 101 – Life Safety Code.
 - 4. IBC – International Building Code.
 - 5. ANSI/ASME A17.1 – Safety Code for Elevators and Escalators.
 - 6. American Disabilities Act (ADA).
 - 7. UL 268 – Standard for Smoke Detectors In Fire-Protective Signaling Systems.
 - 8. UL 864 – Standard for Control Units for Fire-Protective Signaling Systems.
 - 9. UL 1971 – Standard for Signaling Devices for the Hearing-Impaired.

1.3 SUBMITTALS

- A. **SHOP DRAWINGS:** The Contractor shall submit shop drawings within ninety (90) calendar days after award of the type, size, rating, style, catalog number, manufacturer's names, and catalog data sheets for all items to ensure compliance

with these specifications. This equipment shall be subject to approval of the engineer and no equipment shall be ordered without this approval. Equipment devices are shown on the Contract drawings. Provide shop drawings as follows:

1. Complete one-line riser diagram showing all equipment and the size, type and number of all conductors.
2. 1/8" scale floor plan drawings showing all devices, wiring and conduit. Clearly indicate interface with other systems.
3. Scale drawings of the fire alarm panel.
4. Scale drawings of typical multiplexed field panel.
5. Drawings and drawing modifications required for permit.
6. Provide calculations to support the size of standby batteries submitted.
7. Provide calculations to support wire sizing requirements.
8. Include programming and installation manuals.

B. Contract Closeout Submittals ("As Builts"):

1. Deliver two (2) copies to the Owner's representative within thirty (30) days of date of substantial completion and acceptance.
 - a. Installation and programming manuals covering the installed system with electronic copy of all software.
 - b. Point to point diagrams of the entire system as installed. Number all conductors to show all terminations and splices.
 - c. The application program listing for the system as installed at the time of acceptance.
 - d. Name, address and telephone of the authorized factory representative.
2. The Contractor shall provide signed written documentation certifying that the system meets all applicable codes and standards for the application.

C. 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 1 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.
7. Copy of NFPA 25.

D. 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.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be certified by NICET as fire-alarm Level IV technician, trained and certified by the fire alarm manufacturer for installation of units required for this Project
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.
- 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.

1.5 WARRANTY

- A. The Contractor shall warranty all materials, installation and workmanship for one (1) year from the date of substantial completion and acceptance.
- B. All equipment shall be warranted for three (3) years the date of substantial completion and acceptance

1.4 CIRCUITING GUIDELINES FOR SYSTEM

- A. All system sensors (ion / photo / thermal) shall be of addressable analog type for connection to an "intelligent loop." Although each individual device point number and message shall be displayed on the fire alarm panel's LCD, the initiating devices shall be zoned as follows to provide the appropriate indication.
 1. Manual Fire Alarm Stations: Provide 1 alarm initiating zone per device.
 2. Area Smoke / Thermal Sensor: Provide 1 alarm initiating zone per device.
 3. Duct Detectors: Provide 1 alarm initiating zone per device.
 4. Water Flow Switches: Provide 1 initiating zone per device.
- B. Alarm notification devices shall be circuited as follows: Audio devices and strobes: Provide a minimum of 2 circuits per area connected so that adjacent audio devices are not on the same circuit, and the loss of one circuit will not impair the operation of remaining circuits.

PART 2 - PRODUCTS

2.1 EQUIPMENT MANUFACTURERS

- A. All reference to pertinent information herein is supplied to establish minimum standards of performance, function and quality.
- B. Acceptable manufacturers shall be engaged in the manufacture of multiplex point addressable and intelligent fire alarm systems for a minimum of 7 years and have a fully equipped, factory trained authorized service organization within 75 miles.

- C. All equipment shall be new, unused and UL listed. All components and systems shall be designed for uninterrupted duty. All equipment, materials, accessories, devices and other facilities covered by this specification or noted on Contract drawings and installation specifications shall be the best suited for the intended use and shall be provided by a single manufacturer or if provided by different manufacturers, recognized as compatible by both manufacturers. Acceptable manufacturers are:
1. Gamewell / FCI Inc.
 2. GE Security / EST.
 3. Honeywell Fire Systems / Notifier.
 4. Siemens Building Technologies, Inc
 5. SimplexGrinnell

2.2 MAIN PANEL COMPONENTS

- A. Provide all additional components required to accommodate the expansion of the existing main panel, including providing additional sub-panels, amplifiers and other components.

2.3 POWER SUPPLIES

- A. Description: The power supply/charger provides the means of automatically supplying 24 VDC operating and emergency power to the system. The power supply shall be capable of powering up to 3 control modules simultaneously. The power supply shall be a minimum of 80 percent efficient, switch mode solid state design, with built in maximum transient protection (up to 6 kV) including UL recognized EMI filter, spark gaps, transzors and varistors. The power supply shall provide adequate amperage outputs of usable, fully regulated, power limited 24 VDC to operate listed signaling devices. The power supply shall provide diagnostic LEDs to notify the operator upon AC power and/or the control unit CPU failure. The power supply shall contain brown out, low battery detection, system ground fault detection when connected to the network master and shall be capable of recharging the gel electrolyte nonmaintenance type battery to full capacity. Upon AC power failure, the power supply shall automatically transfer the system to battery backup to provide 4 hours of supervised operation. The battery charger may be disabled to provide additional auxiliary output power if required. The power supply / charger shall be used as remote auxiliary power for remote zone panels and may be mounted in any standard cabinet listed above.
- B. Features:
1. High efficiency magnetic field switch mode design.
 2. Completely power limited.
 3. 100 percent fully regulated power supply.
 4. Primary power (AC) presence monitor.
 5. Automatic / demand battery charger circuit.
 6. DC amperage outputs with electronic current limiting.
 7. All conditions monitored and displayed.
 8. Ground fault detection circuit.
 9. Battery monitor circuit; hi/lo voltage and open.
 10. Lead acid compatible.
 11. Battery charging to full capacity.
 12. Instant transfer to battery upon thermal overload.
 13. Relay outputs for alarm, trouble, supervisor condition.
 14. Dedicated output for distributed amplifiers.

15. Transient protected to 6 kV.

2.4 INTELLIGENT / ANALOG POINT ADDRESSABLE SYSTEM COMPONENTS

- A. Description Intelligent Loop I/O Card (DIL): The DIL shall plug into 1 slot in the controller and serve as the interface between the controller and the addressable intelligent analog sensors and single and multizone I/O modules. The DIL is capable of supporting and providing positive point identification for intelligent sensors and I/O modules or multizone I/O modules or may be intermixed. The DIL contains its own dedicated resident Central Processor Unit (CPU) and shall provide power, process, store, control and communicate with sensors and I/O modules via a minimum 18-gauge twisted pair cable up to a maximum of 5,000 feet on copper lines. The controller through the card shall provide for sensitivity adjustment and alarm verification by point, process the analog values from all intelligent devices on its loop and determine normal, alarm and trouble conditions. The intelligent loop returns to the DIL and if a single conductor breaks in the loop, the system shall continue to detect any alarm condition. Communication with devices or addresses shall be performed every 4 seconds or less. The average time to detect an alarm shall be 3 seconds or less. The polling time for the system shall remain the same regardless of the number of intelligent loops in the system.

- B. Intelligent Peripheral Requirements: Provide intelligent analog smoke and thermal sensors as shown. Intelligent analog sensors shall represent the latest in sensor technology. All intelligent sensors, single I/O modules, and multizone I/O modules shall communicate with the DIL card over 2 wires (twisted pair). The address shall be dialed at the sensor by the installer using the rotary switches located in the sensor base, head or module. All intelligent analog sensors shall be interchangeable, ceiling mountable and shall use common twist-lock bases. All sensors shall provide dual alarm LEDs. Both LEDs shall flash under normal operating and communication conditions, and both LEDs shall illuminate at steady state when the sensor's sensitivity level (analog value) exceeds the predetermined limit and commands from the control panel place the sensor into the alarm state. All sensors shall include a test means, whereby the sensor's actual analog value and the number of times the sensor has entered the alarm verification mode shall be vectored to a hard copy printer, or by locally activating the sensor's internal magnetic switch. Activating the sensor remotely by a control panel command without the control panel being in other than the test mode, shall not be allowed. When the sensors reach a predetermined sensitivity, the network master shall automatically display a maintenance alert message. All single I/O modules shall contain an alarm LED that shall flash during normal operation and communication and shall go to a steady state when commanded by the control panel that an alarm or supervisory value has been detected.

- C. Intelligent Ionization Sensor: The intelligent ionization sensor shall be easy to install into a twist-lock base. The sensor shall incorporate a built-in type identification so the system can identify the type of sensor. The sensor shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, smoke, temperature, humidity, etc.). The sensor shall use the ionization principle to measure products of combustion. The sensor shall provide advanced indication of the analog value of the products of combustion to the control panel that maintenance is required, thus reducing the maintenance required to inspect routinely all sensors, in order to ensure normal operation. The sensor sensitivity shall be adjustable per device (within UL limits).

- D. Intelligent Photoelectric Sensor: The intelligent photoelectric sensor shall be easy to install into a twist-lock base. The sensor shall incorporate a built-in type identification so the system can identify the type of sensor. The sensor shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, smoke, temperature, humidity, etc.). The sensor shall use the photoelectric principle to measure smoke density and shall on command from the control panel, send data to the panel representing the analog value of the smoke density. The sensor shall provide advanced indication of the analog value of the level of smoke density to the panel that maintenance is required, reducing the maintenance required to inspect routinely all sensors, in order to ensure normal operation. The sensor sensitivity shall be adjustable per device.
- E. Intelligent Beam-Type Smoke Detector: Each detector consists of a separate transmitter and receiver with the following features:
1. Adjustable sensitivity over a 6-level range, minimum.
 2. Linear Range of Coverage: 600 feet (183 m), minimum.
 3. Tamper switch initiates trouble signal at the central FACP when either transmitter or receiver is disturbed.
 4. Separate color-coded LEDs indicate normal, alarm, and trouble status. Any detector trouble, including power loss, is reported to the central FACP as a composite "trouble" signal.
 5. Provide intelligent monitor module for fully addressable system.
- F. Intelligent Thermal Sensor: The intelligent analog thermal sensor shall be easy to install into a twist-lock base. The sensor shall incorporate a built-in type identification so the system can identify the type of sensor. The sensor shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, smoke, temperature, humidity, etc.). The sensor shall use dual solid state thermistors and shall monitor the ambient temperature from -10 degrees C, to +60 degrees C and provide a fast response to rapid increases in temperature. The sensor on command from the control panel shall send data to the panel representing the analog value of the ambient temperature.
- G. Intelligent Monitor Module: The intelligent monitor module shall be used to connect supervised conventional initiating device or zone of supervised conventional initiating devices (water flow switches, tamper switches, manual pull stations, 4 wire smoke detectors, conventional 4 wire duct detectors, etc. to one of the 2 wire intelligent analog loop cards. The intelligent monitor module shall mount in a 4-inch square, 2-1/8-inch deep electrical box and shall be capable of Class "A" or "B" supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on Class "A" lines. The intelligent monitor module shall mount behind the manual station in a single gang electrical box. The monitor module shall provide address setting means using rotary decimal switches and also store an internal identifying code which the control panel shall use to identify the type of device. The monitor module shall contain an integral LED that flashes each time the monitor module is polled.
- H. Intelligent Control Module: The intelligent control module shall be used to connect and supervise conventional indicating device or zone of indicating devices that require an external power supply, such as horns, strobes, bells, speakers or telephones to one of the 2 wire intelligent analog loop cards (Class "B"). The control module shall be capable of operating as a relay (dry contract form C), to control door holders, air handling units, etc. The intelligent control module shall mount in a 4-inch square, 2-1/8-inch deep electrical box and shall be capable of Class "A" or "B"

supervised wiring to the indicating or control device. The control module shall contain an integral LED that shall flash each time the module is polled. The control module shall provide address setting means using rotary decimal switches and also store in internal identifying code which the control panel shall use to identify code which the control panel shall use to identify the type of device.

- I. Isolation Module: The isolation module shall be an automatic switch, which will open when the intelligent loop voltage drops below 4 volts. The isolator module shall be placed between groups of sensors/intelligent modules on the loop in order to protect the intelligent loop if a short (less than 4 volts) should occur. If a short occurs between any 2 isolators, then both isolators switch to an open circuit condition and isolate the group of sensors /modules between them. The remaining devices on the intelligent loop shall continue to operate and communicate normally. The number of devices between isolators shall be 25 or less. The isolator shall be designed to mount in a 4-inch square, 2-1/8-inch electrical box.
- J. Duct Detector: Duct detector shall be intelligent ionization sensor with suitable housing and sampling tubes designed for duct mounting. The sampling tubes shall be installed across the width of the duct in the air system. The detector shall be provided with contacts for associated air handling unit shut down and remote alarm indication. Detector shall include auxiliary relay with contacts for alarm annunciation to the Division 15 direct digital control (DDC) system and to a remote alarm indicator. Duct detectors shall be supplied with LED-type remote alarm indicators.

2.5 PERIPHERAL EQUIPMENT

- A. Manual Stations: Provide manual station as shown, the single action manual station shall be of the noncoded type with terminals and contain an internal toggle switch. The red manual station shall be constructed of rugged aluminum with a key reset switch for positive resetting action and shall be available with an optional break glass rod. The manual station shall mount to a standard single gang switch box.
- B. Alarm Indicating Devices:
 - 1. General: Equip alarm indicating devices for mounting as indicated. Provide terminal blocks for system connections.
 - 2. Alarm speakers shall be UL listed, suitable for flush mounting in wall box. Provide cover grille with red finish. Unit shall have a minimum rating of 2 watts with a minimum sound rating of 85 dbA at 4 feet when tapped at 1/4 watt. Provide line matching transformer to match amplifier output (25 volt line) with taps for 1/8, 1/4, 1/2, 1, and 2 watts. Minimum frequency response 300 Hz. to 10,000 Hz. Unit to have double projector attachment if shown on the plans.
 - 3. Visual Alarm Signals: 24 V d.c. strobe lights utilizing high intensity, clear, optic lens and xenon flash tube. Provide luminaires having their lenses mounted on an aluminum face plate. Provide the word "FIRE" engraved in minimum 1-inch high letters displayed on the unit. Provide strobe lights complying with UL 1971 standard "Signaling Devices for the Hearing Impaired," 1994 edition.
 - 4. Combination Signals: Provide factory-combined audible and visible alarm units of type indicated in a single mounting unit where indicated. Combination units shall be wired such that the alarm initiating circuits are separate for audio and visual devices.

2.7 REMOTE DEVICE LOCATION-INDICATING LIGHTS AND IDENTIFICATION PLATES

- A. Description: An LED-indicating light in the vicinity of each sprinkler water-flow switch and valve tamper switch denotes the associated device is in an abnormal or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, the room where the valve is located or the protected spaces downstream from the water-flow switch.

2.8 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Electromagnet operates from a 120-V ac source and requires no more than 3 W to develop 25-lbf (111-N) holding force.
- B. Material and Finish: Match door hardware.

2.9 GRAPHIC COMMAND CENTER

- A. Provide computer graphic work station for F.A. System

2.10 FIRE ALARM AND PROTECTIVE SYSTEM SEQUENCE OF OPERATION

- A. General Requirements: The network master shall support addressable / analog sensors and modules as well as traditional initiating and indicating circuits simultaneous intermixed in any controller. In the sequence of operations described below, an indicating circuit may be traditional Class "A" or "B" or addressable module configured Class "A" or "B." In the description below, a signaling circuit (horns, strobes, speakers or emergency telephone) may be a traditional Class "A" or "B" or an addressable module configured Class "A" or "B." Initiating circuits used for manual stations, waterflow, tampers, 4 wire duct detectors, etc., shall be addressable I/O modules or traditional Class "A" or "B" circuits.
- B. Sequence of Operation: The operation of a manual station or activation of any area smoke detector, elevator smoke detector, duct smoke detector, thermal detector, sprinkler waterflow switch, or any automatic alarm initiating device shall automatically:
 1. Sound all speakers throughout the building. Provide selection of alarm tone or pre-recorded digitized voice record system activation by Owner.
 2. Flash all alarm lights/strobes throughout the building. Silencing the alarm devices (audible circuit) shall not automatically turn off flashing alarm lamps / strobes.
 3. Initiate the transmission of an alarm to central station selected by the Owner or his representative. This section, its fees and fees for any telephone lines are the sole responsibility of the Owner or his representative.
 4. Visually indicate the control panel LCD and graphic display screen device or the circuit of alarm initiation. When the control panel goes into the alarm condition the (green) normal LED shall extinguish the (red) alarm LED shall light, the buzzer shall pulsate and the display LCD shall indicate the real time, the number of messages waiting, the type of alarm, the alarm zone number, the time that the alarm occurred, and shall display the user specified message. In order to reduce false alarms, all inputs shall be capable of alarm verification (analog / addressable, traditional, I/O modules). The system shall be capable of setting the sensitivity of all analog sensors by point and be capable of displaying the analog value of the sensor by device and/or traditional input and vectoring the value to the printer. The system

shall automatically identify any analog sensor which becomes dirty (maintenance alert) prior to false alarming.

- a. The operator shall acknowledge that alarm by pressing the acknowledge button, and the buzzer will silence providing there is not an additional alarm pending. If there are additional alarms waiting, the operator shall acknowledge all pending alarms before the buzzer will silence. To silence audible devices, the operator shall press the alarm silence button, a new alarm shall cause the audibles to resound. To reset the system, the operator shall press the reset button.
 5. Print a record of alarm on the system printer by time, alarm zone or device number, alarm type and the use specified message. All restorations shall likewise be recorded, except the user specified message shall not be repeated.
 6. Operate prioritized outputs to release all magnetically held smoke doors and magnetically locked doors throughout the building.
 7. Operate prioritized output to release Type 3 series access control doors as indicated on the drawings.
- C. Activation of a supervisory condition such as a sprinkler valve tamper switch:
1. Display on the control panel LCD and graphic display screen the zone or the addressable device from which the off normal (active point) condition was initiated. During the supervisory condition, the amber supervisory LED shall light, the normal LED shall go out, and the buzzer shall pulsate. The LCD shall indicate ("SUPERV.SHORT") and the zone/device number. The operator shall silence the buzzer by acknowledging all messages and pressing the trouble silence button.
 2. Operate the prioritized output to initiate transmission to the central station.
- D. Fire pump power failure, including a dead phase or phase-reversal condition, causes or initiates the following:
1. A supervisory, audible, and visible "fire pump power failure" signal indication at the FACP and the annunciator.
 2. A printed record of the event on the system printer.
 3. Transmission of trouble signal to remote central station.

2.11 WIRING

- A. Wiring shall comply with NFPA 72. Where required, 2-hour fire rated circuit integrity cable listed to UL 2196 shall be used.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The entire system shall be installed in a workmanlike manner in accordance with approved manufacturers manuals and wiring diagrams. The Contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the NEC, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout (maximum 40 percent fill for conduits).

- B. All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.
- C. End of Line Resistors: Shall be furnished as required for mounting as directed by the manufacturer.
- D. All wiring shall be color coded throughout, and shall be in conduit to NEC standards and a minimum of No. 14 AWG, unless otherwise noted.
- E. Field Quality Control: The system shall be installed and fully tested under the supervision of trained manufacturer's representative. The system shall be demonstrated to perform all the functions as specified.
- F. All outlet boxes, pull boxes and junction boxes shall be painted red on the exterior and shall be installed in accordance with specification Section 16131.
- G. Cable for RS 232-C devices (CRT, printer) shall be dual pair twisted-shielded installed in conduit.
- H. Provide 1/2-inch conduit from control panel to nearest telephone terminal backboard with remote alarm conductors and trouble conductors.
- I. Provide wiring and conduit for connection to all sprinkler flow switches, tamper switches and fire pump system.
- J. Provide wiring and conduit for connection of lobby detectors to elevator control systems for all the elevators (3).
- K. Provide wiring and conduit for duct mounted smoke detectors to shut down their respective air handling units.
- L. Provide wiring and conduit to fire pump controller for monitoring per NFPA 20 requirements.
- M. Fire alarm control panel shall be connected to a separate dedicated emergency power branch circuit, maximum 20 amperes. Circuit shall be labeled as "fire alarm." Provide point of use 30 minute minimum UPS for all fire alarm system panels.
- N. Contractor shall provide the Owner with two "spare" detectors for each type installed. These units shall be in their original factory packaging and shall clearly indicate manufacturer and model number.
- O. Elevator control circuits shall be provided for shutdown and recall. Provide wire and conduit to each elevator controller.

3.2 DUCT-MOUNTED DETECTORS

- A. Sampling tubes shall be factory drilled with the number and size of holes required for duct size.
- B. Sampling tubes shorter than 48 inches shall be supported at the remote end by a support mounted on inside of the duct. Tubes longer than 48 inches shall be supported with a "V" bracket or strap hanger. Supports shall not cover any holes in

sampling tubes. Remote end of tubes shall not penetrate opposite duct walls. Relief tube shall extend a minimum of 2 inches beyond any internal insulation or duct wall.

- C. Duct access panels, as specified in Division 15, shall be provided at all locations where sampling tubes are installed.
- D. Air Duct Velocity: Shall be checked on each duct detector and the reading included in the test report by the technician.
- E. Provide smoke detectors in the air ducts indicated for each individual air-handling unit. Provide shutdown contacts for operation with air handling control circuit. Detector location shall be approved by local authority having jurisdiction and shall meet manufacturer's recommendations for correct operation. Detectors shall annunciate as an individual zone for each air handling unit.

3.3 DETECTOR INSTALLATION

- A. Detectors shall not be installed until project is complete, painted and final cleaning has taken place. Detector used for testing or installed prior to final project cleanup will not be accepted for final installation.
- B. Elevator lobby detectors shall have relay provisions for operation with elevator controls.
- C. Detectors and alarms for elevator machine rooms shall be approved by local authority having jurisdiction. Contractor shall obtain approval of local Fire Marshal and elevator inspector prior to installation of equipment.

3.4 TESTS

- A. Reports of any testing during installation shall be forwarded to the engineer.
- B. Each individual system operation on a point basis shall be tested for its complete operation. Procedures for testing the entire fire alarm system shall be set forth with the consent of local authority having jurisdiction, the engineer and the manufacturer. A hard copy of the analog value of each initiating input/device (addressable point and traditional zone) shall be given to the engineer upon completion of system test. This copy shall be used as reference in future tests to determine sensor maintenance.

3.5 TRAINING

- A. In addition to requirements 1.3.B Closeout Submittals, and a manufacturer's recommended spare parts list, the Contractor shall provide the services of the manufacturer's trained representative for a period of 4 hours, during normal business hours, to instruct the Owner's designated personnel on the operation and routine maintenance of the system.

END OF SECTION 28.31.10

**SECTION 31 05 16
AGGREGATE MATERIALS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aggregate materials.

1.2 REFERENCES

- A. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb Rammer and 18 inch Drop.
- C. ASTM D2487 - Classification of Soils for Engineering Purposes.
- D. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.3 SUBMITTALS FOR REVIEW

- A. Section 01 33 00 - Submittals: Procedures for submittals.
- B. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.

1.4 SUBMITTALS FOR INFORMATION

- A. Section 01 33 00 - Submittals: Procedures for submittals.
- B. Materials Source: Submit name of imported materials suppliers.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Standard Specification for Construction Minnesota Department of Transportation.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

- A. Coarse Aggregate Type A1 (Pit Run Gravel): Granular backfill material shall be pit-run or crusher-run mineral product that will all pass a 3-inch

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sieve and that is so graded from coarse to fine that, the ratio of the portion passing the #200 sieve divided by the portion passing the 1-inch sieve may not exceed 20 percent by mass.

- B. Coarse Aggregate Type A2 (Class 5): The mixture shall consist of 100 percent virgin aggregates and shall consist of sound durable particles or fragments of gravel and sand, crushed quarry or mine rock, crushed gravel or stone or any combination thereof meeting the following gradation requirements:

| | Minimum |
|----------|----------------|
| 1 inch | 100 |
| ¾ inch | 90-100 |
| 3/8 inch | 50-90 |
| No. 4 | 35-80 |
| No. 10 | 20-65 |
| No. 40 | 10-35 |
| No. 200 | 3-10 |

- C. Aggregate Type A3 (Pea Gravel): Fine filter aggregate shall be a free draining mineral product, excluding crushed carbonate quarry rock, crushed concrete, and salvaged bituminous mixtures, and meeting the following gradation requirements:

| | Minimum |
|----------|----------------|
| 3/8 inch | 100 |
| No. 4 | 90-100 |
| No. 10 | 45-90 |
| No. 40 | 5-35 |
| No. 200 | 0-3 |

2.2 FINE AGGREGATE MATERIALS

- A. Fine Aggregate Type A4 (Sand): Sand material shall consist of sound durable particles of sand and gravel meeting the following gradation requirements:

| | Minimum |
|---------|----------------|
| No. 4 | 100 |
| No. 10 | 95-100 |
| No. 40 | 0-50 |
| No. 200 | 0-8 |

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Control: Source testing and analysis of aggregate material.

- B. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D 2487.
- C. Fine Aggregate Material - Testing and Analysis: Perform in accordance with ASTM D 2487.
- D. If tests indicate materials do not meet specified requirements, change material or material source and retest.
- E. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 STOCKPILING

- A. Stockpile materials on site at locations designated by Architect.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Direct surface water away from stockpile site so as to prevent erosion or deterioration of materials.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.
- B. If a borrow area is indicated, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

**SECTION 31 20 00
EARTH MOVING**

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide building excavation, dewatering, fill, backfill and compaction specified and shown on the drawings. Included is preparation of subgrade for footings, slabs and pavement within the general building area.

1.2 SUBMITTALS

- A. Test Reports: The independent testing lab shall submit copies of the following reports to the Architect-Engineer and Owner:
 - 1. Report and certification of backfill and fill materials.
 - 2. Test reports on borrow material.
 - 3. Verification of each footing subgrade.
 - 4. Field density test reports.
 - 5. One optimum moisture-maximum density curve for each type of soil encountered.
 - 6. Other tests and material certificates, as required.

1.3 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards except as otherwise shown or specified:
 - 1. Governing Local Building Code.
 - 2. American Society for Testing and Materials (ASTM) C136 -- Standard Test for Sieve Analysis of Fine and Coarse Aggregates
 - 3. ASTM D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)
 - 4. ASTM D1556 Standard Test method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - 5. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)
 - 6. ASTM D 2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

7. ASTM D 2922 – Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- B. Regulations: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.
- C. Inspection Testing Laboratory: The Owner shall employ and pay an independent geotechnical testing laboratory, acceptable to the Architect-Engineer, to perform sampling and testing of soil materials proposed for use in the work, field observation and testing for quality control during earthwork operations. All testing and inspection shall be performed by an Inspector Type Technical II as indicated in Division 01 Structural Tests and Special Inspections.

1.4 PROJECT / SITE CONDITIONS

- A. Site Information: The data on subsurface conditions shall be as interpreted in the Project Geotechnical Report, prepared by Braun Intertec dated September 28, 2012, and the General Conditions. Additional test borings and other exploratory operations may be made by the contractor at no cost to the Owner.
- B. Verify that survey bench marks and intended elevations for the Work are as indicated in the Contract Documents.
- C. Existing Utilities: Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protecting during excavation operations.
 1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the utility owner immediately for directions. Cooperate with the Owner, the public and private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility Owner.
 2. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, except when permitted in writing by the Architect-Engineer and then only after acceptable temporary utility services have been provided.
 3. Demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with local utility companies for shut-off of services if lines are active.
- D. Use of explosives is not permitted.
- E. Protection: Protect structures, utilities, sidewalks, pavements and other facilities from damages caused by settlement, lateral movement, undermining, washout and other hazards created by excavation operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Non-Frost Susceptible (NFS) Engineered Fill: Gradation as defined in the Project Geotechnical Report.
- B. General Engineered Fill: Non-organic granular material as defined in the Project Geotechnical Report. Existing on site fill may NOT be used as engineered fill.

2.2 COMPACTION EQUIPMENT

- A. Vibratory Rollers: The vibratory drum roller shall have the following minimum requirements:
 - 1. Drum Roller: 36 to 48 inches in diameter.
 - 2. Static at Drum Weight: 6,000 to 10,000 pounds.
 - 3. Approved compactors include Galion, Dynapac and Bros.
 - 4. Vibratory compaction shall be performed so as not to damage existing structures. Rollers shall not be used adjacent to the existing structures or within a distance which will have an adverse effect. When compacting within 15 feet of the existing structure, a lightweight walk-behind sled or roller compactor should be used. Use mechanical hand equipment or alternate compaction equipment as needed.
- B. Alternate Compaction Equipment: Steel wheeled or pneumatic-tired nonvibratory rollers capable of meeting the compaction requirements specified herein. Use adjacent to existing structures.
- C. Mechanical Hand Equipment: Hand vibratory sleds, rollers and tampers shall be capable of meeting the compaction requirements specified herein. Total weight shall be on the order of 100 to 500 pounds.

2.3 SOURCE QUALITY CONTROL

- A. Testing: The independent testing laboratory shall perform the following:
 - 1. Test soil materials proposed for use in the work and promptly submit test result reports.
 - 2. Provide one optimum moisture-maximum density curve for each type of soil encountered in subgrade and fills under building slabs and foundations and paved areas. Determine maximum densities in accordance with ASTM D1557.
 - 3. For backfill and fill materials, perform a mechanical analysis, AASHTO T88; plasticity index, AASHTO T90; and moisture-density curve, AASHTO T180 or ASTM D1557.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions under which building excavation and fill is to be performed and do not proceed with the work prior to correcting unsatisfactory conditions.

3.2 CLEARING AND STRIPPING BUILDING AREAS

- A. Clear and strip the entire building area to at least 10 feet beyond perimeter to building footings and foundation, walks and slabs to remove existing vegetation, concrete and asphalt pavement layers and other obstructions to the work.
- B. Strip topsoil from areas within the building and slab areas and stockpile on the site for future use in site grading.

3.3 COMPACTION OF EXPOSED SOILS

- A. No compactive effort should be used on exposed soils.

3.4 EXCAVATION

- A. Excavation consists of the removal and disposal of materials encountered when establishing the required grade elevations for the site including footings, utilities and all other items indicated in the drawings and specifications.
- B. If any existing or former building foundations or any other unexpected subsurface conditions are encountered in the required excavation, notify the Architect-Engineer immediately.
- C. Earth excavation includes the removal and disposal of pavement and other obstructions visible on the ground surface, under-ground structures and utilities to be demolished and removed, material of any classification indicated in data on subsurface conditions (existing fill, topsoil, organics, etc. as defined on the drawings and the project geotechnical report), and other materials encountered that are not classified as unauthorized excavation.
- D. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or side dimensions –as defined in the Project Geotechnical Report. Unauthorized excavation, as well as remedial work shall be at the Contractor's expense. Backfill and compact unauthorized excavations as specified for authorized excavations of the same classification, unless otherwise directed by the Architect - Engineer.

EARTH MOVING

- E. Additional Excavation:
1. When excavation has reached required subgrade elevations, notify the independent testing laboratory which shall make an inspection of conditions.
 2. If unsuitable bearing materials are encountered at the required subgrade elevations, carry excavations deeper and replace the excavated material as directed by the Geotechnical Engineer.
 3. If an excavation extends below the bottom of footing elevation in suitable bearing material, a 1H:1V excavation oversize shall be required for every foot of new General Engineered Fill placed below the base of the footing. The contractor shall not receive additional compensation.
 4. Removal of unsuitable material in excess of one foot in depth and its replacement as directed will be paid on the basis of contract conditions relative to changes in the work.
- F. Stability of Excavations:
1. Comply with local codes and ordinances and requirements of agencies having jurisdiction. Slope sides of excavations as necessary for stability and compliance. Shore and brace where sloping is not possible either because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in a safe condition until completion of backfilling. Refer to the Geotechnical Report for further excavation stability requirements.
 2. Shoring and Bracing: Provide shoring and bracing designed for and adequate to resist all imposed loads.
- G. Dewatering:
1. Prevent surface water and subsurface or ground water from flowing into the excavations and flooding the project site and surrounding area.
 2. Do not allow water to accumulate in excavations. Remove water from excavations to prevent softening of foundation bottoms, undercutting footings and soil changes detrimental to the stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines and other dewatering system components necessary to convey the water away from excavations.
 3. Convey water removed from excavations and rainwater to collecting or run-off area. Establish and maintain temporary drainage ditches and other diversions outside the excavation limits for each structure. Do not use trench excavations for site utilities as temporary drainage ditches.
 4. Provide groundwater control as required to maintain groundwater levels at least 12 inches below the bottom of any excavation made during construction and at least 24 inches below the surface of any vibratory compaction operations.
- H. Material Storage:

1. Stockpile excavated materials classified as satisfactory soil material where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
2. Locate and retail fill materials away from edges of excavations.
3. Dispose of excess soil material and waste materials as herein specified.

I. Excavation for Structures:

1. Conform to the elevations and dimensions shown on the drawings, within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction and for inspection.
2. After excavating footings and foundations to approximate bearing elevations, perform final excavation in the presence of the Inspection and Testing Service Representative.
 - a. In excavating for final grading of footings and foundations, take care not to disturb the bottom of the excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to the required lines and grades to leave a solid base to receive concrete.

J. Excavation for Trenches: Dig trenches to the uniform width required for the particular item to be installed, sufficiently wide to provide ample working room.

1. Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations. Beyond the building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.
2. Grade bottom of trenches as indicated, notching under pipe bells to provide solid bearing for the entire body of the pipe.
3. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below the bottom of such footings, or which pass under wall footings. Place concrete to the level of the bottom of adjacent footing. Concrete is specified in Division 3.
4. Do not backfill trenches until tests and inspections have been made and backfilling authorized by the Architect-Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

K. Closing Abandoned Underground Utilities: Fully grout any abandoned underground utilities not indicated to be removed.

L. Cold Weather Protection: Protect excavation bottoms against freezing when the atmospheric temperature is less than 35 degrees F.

3.5 BACKFILL AND FILL

A. General:

EARTH MOVING

1. In all excavations, use borrow material that has been sampled, tested and approved by the soil testing agency.
2. Backfill excavations as promptly as the work permits, but not until completion of the following:
 - a. Completion of construction below finish grade including, where applicable, damproofing, waterproofing and perimeter insulation.
 - b. Inspection, testing, approval and recording locations of underground utilities.
 - c. Removal of concrete framework.
 - d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
 - e. Removal of trash and debris.
 - f. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

B. Placement and Compaction:

1. Place backfill and fill materials in layers not more than 8 to 10 inches in loose depth for material compacted by vibratory compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
2. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content of the soil material. Compact each layer to the required percentage of maximum dry density or relative dry for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.
3. Place backfill and fill materials evenly adjacent to structures, to the required elevations. Take care to prevent wedging action of the backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift. Do not overcompact against retaining walls and structures. Provide temporary bracing for retaining walls which are backfilled prior to construction of any restraining slab or other element.

C. Backfill at Specific Locations:

1. Floor slabs shall bear on a drainage sand layer over engineered fill as defined in the Project Geotechnical Report.
2. Retaining Wall Backfill (including building basement walls): Backfill at retaining (basement) walls shall consist of sand fill with gradation as defined in the Project Geotechnical Report.

3.6 COMPACTION

- A. General: Control soil compaction during construction for compliance with the percentage of density specified in the project geotechnical report.
- B. Moisture Control:
 - 1. Where the subgrade or layer or soil material must be moisture conditioned before compaction uniformly apply water to the surface of subgrade, or layer of soil material, to prevent free water appearing on the surface during or subsequent to compaction operations.
 - 2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
 - 3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until the moisture content is reduced to a satisfactory value.

3.7 FIELD QUALITY CONTROL

- A. Allow independent testing laboratory to inspect and approve subgrades and fill layers before further construction work is performed.
- B. The independent testing laboratory shall perform the following:
 - 1. Field density tests in accordance with ASTM D1556 (sand cone method) or ASTM D2922 (nuclear method).
 - 2. Footing Subgrade: For each strata of soil on which footings will be placed, conduct, at least one density test to verify the required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with the related tested strata, when acceptable to the Architect-Engineer.
 - 3. Paved Areas and Building Slab Subgrade: Make at least one field density test of the subgrade and each lift of compacted fill for every 5,000 square feet of paved area or building slab, but in no case less than three tests at each level.
- C. If, in the opinion of the Architect-Engineer, based on testing service reports and inspection, the subgrade or fills which have been placed are below the specified density, provide additional compaction and testing at no additional expense.
 - 1. The results of density tests will be considered satisfactory when the average of any four consecutive test are each instance equal to or greater than the specified density, and if not more than one density test out of five has a value greater than two percent below the required density.

3.8 PROTECTION

- A. Protection of Graded Areas:
 - 1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
 - 2. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.
- B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, re-shape and compact to the required density prior to further construction. Use hand tamping for re-compaction over underground utilities and underfloor subdrains, if any.

3.9 DISPOSAL OF EXCESS AND WASTE MATERIAL

- A. Removal from Owner's Property: Remove all waste materials, including excavated material classified as unsatisfactory soil material, trash and debris, and legally dispose of it off the Owner's property.

3.10 TESTING AND INSPECTION

- A. General: Inspection and testing of soils shall conform to the requirements of Section 1704.7 of the International Building Code, 2006 Edition in addition to other requirements as stated herein.

END OF SECTION 31 20 00

SECTION 32 92 00 TURF AND GRASSES**PART 1 - GENERAL****1.01 SCOPE OF WORK**

- A. The conditions of the Contract and the Provision of Division 01 apply to all work of this Section.
- B. This Section includes furnishing and placing fertilizer, sod and seed where indicated on plan. Prior to delivery, visit the site to review topsoil placement and finish grading to assure minimum erosion potential damage to turf areas. Do not begin work under this Section until surfaces are acceptable to receive turf materials.
- C. Related Work Specified Elsewhere:
 - 1. Plants - Section 32 93 00

1.02 SUBMITTALS

- A. Submit samples of sod material to be used for Architects approval prior to laying any sod.

PART 2 - PRODUCTS**2.01 MATERIALS (FERTILIZER)**

- A. One initial application to topsoils. Materials shall be ureaform or nitroform fertilizer delivered in original unopened containers with the analysis, type and trade name attached to each container. Analysis shall be: nitrogen 10%, phosphorus 10% and potash 10%. Rate of fertilizer application shall be 10 lbs. per 1,000 sq. ft.

2.02 MATERIALS (SOD)

- A. Submit sample prior to approval of materials to be furnished.
- B. Sod shall be well seasoned sod cut no earlier than normal industry season sod growth periods for the sod source region.
- C. Sod shall be of mineral soil source and shall be highland cultured sod. Thickness of cut shall be 3/4" + or - to permit rapid rooting into topsoils and adequate to avoid reveling or drying conditions. Conform to industry standards and practices described under MnDOT Section 3878 Sod. The following blend of materials may be approved on sample review. Generally, uniform combination of a blend of at least two of the following Bluegrass varieties, with minor quantities of red top, perennial fescue or perennial ryegrass: Rugby, Parade, Glade, Adelphi, Baron, Aquilla and Park (all Bluegrass varieties).

PART 3 - EXECUTION**3.01 CONSTRUCTION REQUIREMENTS (FERTILIZER)**

- A. Incorporate uniformly to a minimum depth of 2 to 4 inches. Coordinate with other operations to avoid compaction and grade disturbance.

3.02 CONSTRUCTION REQUIREMENTS (SOD)

- A. Conform with MnDOT Section 2575, Turf Establishment, excluding maintenance period which is defined under this project specification.
- B. The contractor will be required to perform all maintenance and any other necessary maintenance operations during the time period through sod placement until acceptance of the completed sod work. The work will be accepted when turf materials are established to control erosion.
- C. Re-sod at no extra cost to the Owner, where sod fails to become established, or where erosion loss occurs. Maintain until established.

END OF SECTION

SECTION 32 93 00 PLANTS**PART 1 - GENERAL****1.01 SCOPE OF WORK**

- A. The Conditions of the Contract and the Provisions of Division 01 apply to all work of this Section.
- B. This Section includes furnishing all labor, materials and equipment necessary to place plant materials as shown on the drawings and specified herein.
- C. Related work specified elsewhere:
 - 1. Turf and Grasses - Section 32 92 00

1.02 SUMMARY

- A. Section Includes:
 - 1. Plants.
 - 2. Planting soils.
 - 3. Tree stabilization.
 - 4. Planting bed Edging
 - 5. Taconite Screenings

1.03 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- D. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- E. Finish Grade: Elevation of finished surface of planting soil.
- F. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- G. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

- H. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- I. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- J. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- K. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

1.04 SUBMITTALS

- A. Shop Drawings: Submit shop drawings, for review and approval, showing tree and shrub planting details.
- B. First two paragraphs below are defined in Division 01 Section "Submittal Procedures" as "Action Submittals."
- C. Product Data: For each type of product indicated, including soils.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - 2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
- D. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- E. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis of standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- F. Material Test Reports: For existing native surface topsoil and imported or manufactured topsoil.
- G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful Meadow establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 2. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Soil Analysis: For each un-amended soil type, contractor shall furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter, which must be above 3%; gradation of sand, silt, and clay content, clay content must be below 40%; cation exchange capacity; deleterious material; pH, which should be between 5.0 and 8.2; and mineral and plant-nutrient content of the soil.
1. Report suitability of tested soil for meadow growth.
 - a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1,000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock".
- E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
1. Trees and Shrubs: Measure with branches and trunks in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size.
 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- F. Plant Material Observation: Engineer may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Engineer retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees shrubs or other plants immediately from Project site.
1. Notify Landscape Architect of sources of planting materials 21 days in advance of delivery to site.
- G. The Contractor shall keep on the work site a copy of the drawings and specifications and shall at all time give the Landscape Architect or Owner's Representative access thereto. Any adjustment made by the Contractor without a determination issued by the Landscape Architect or Owner's Representative shall be at the Contractor's own risk and expense.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.
- C. Deliver plants freshly dug.
- D. Do not prune trees and other plants before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- E. Handle planting stock by root ball.
- F. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in the shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 2. Do not remove container-grown stock from containers before time of planting.
 - 3. Water root systems of plants stored on-site deeply and thoroughly. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
- C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Planting Completion.

1. Spring Planting: Any time March 15- June 15th
 2. Fall Planting: Any time after August 30th.
- D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- E. Coordination with Turf Areas: Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas, unless otherwise indicated.

1.08 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization.
 2. Warranty Periods from Date of Planting Completion and acceptance:
 - a. Trees, Shrubs, and Ornamental Grasses: 24 months.
 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.09 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Trees, Shrubs and Ornamental Grasses: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
1. Maintenance Period: 24 months from date of Planting Completion including watering.

PART 2 - PRODUCTS

2.01 PLANT MATERIALS

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in the Plant List shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 - 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than $\frac{3}{4}$ inch in diameter; or with stem girdling roots will be rejected.
 - 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Engineer, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

2.02 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

2.03 FERTILIZER

- A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.04 PLANTING SOILS

- A. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

1. Mix existing, native surface topsoil with soil amendments and fertilizers to produce planting soil:
- B. Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from bogs, or marshes.
 1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants; not infested with nematodes; grubs; or other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration.
 2. Mix imported topsoil or manufactured topsoil with soil amendments and fertilizers to produce planting soil.
- C. Type 1 Soil: Area refer to drawings
 1. Mixture of 1/3 pulverized existing soil, 1/3 planting soil, 1/3 sandy loam.
- D. Type 2 Soil: Area refer to drawings
 1. Mixture of 1/3 planting soil, 1/3 compost, 1/3 sandy loam.

2.05 MULCH

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 1. Type: Ground or shredded bark.
 2. Size Range: 3 inches maximum, 1/2 inch minimum.
 3. Color: Natural- To match Phase I plant installation.

2.06 ALUMINUM EDGING

- A. Taconite strip edging -Permaloc PermaStrip aluminum edging 16'-straight lines.
 1. 12" Aluminum stakes, o.c. as per manufacturer.
 2. Mill finish or approved equal.
 3. Located at taconite edging strips -except near terminal building.
- B. Planting bed edging- Permaloc PermaStrip aluminum edging 8', notched curves.
 1. 12" Aluminum stakes, o.c. as per manufacturer.

2. Mill finish or approved equal.
3. Located at planting beds and sod areas- except near terminal building.

2.07 TACONITE SCREENINGS

- A. Submit sample for approval #2- 3/8" minus w/fines- power tamp in place.
- B. Install where indicated on plan.
- C. See Drawings for subbase.

2.08 GEOTEXTILE FABRIC

- A. Heavy duty Weed barrier Fabric- type special, MNDOT 2575.604.
- B. Install under taconite screenings in all areas that do not have planting in the planting beds.
- C. Install in all areas that have taconite screenings only, no trees planted above.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil

3.02 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.03 PLANTING AREA ESTABLISHMENT

- A. Loosen sub grade of planting areas to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply slow-release fertilizer directly to sub grade before loosening.
 - 2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 1. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.
 - 2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 - 4. Maintain required angles of repose of adjacent materials. Do not excavate sub grades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 - 5. Maintain supervision of excavations during working hours.
 - 6. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
- B. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.05 TREE AND SHRUB PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 3 inches above adjacent finish grades.
 - 1. Use planting soil, 50 percent subsoil and 50 percent topsoil for backfill.
 - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Backfill with planting soil around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Set container-grown stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 - 1. Use planting soil, 50 percent subsoil and 50 percent topsoil for backfill.
 - 2. Carefully remove root ball from container without damaging root ball or plant.
 - 3. Backfill with planting soil around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- F. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.06 TREE AND SHRUB PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees and shrubs as directed by Landscape Architect.
- C. Prune, thin, and shape trees and shrubs according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

- D. Do not apply pruning paint to wounds.

3.07 TREE STABILIZATION

- A. Install trunk stabilization as follows unless otherwise indicated:
 - 1. Upright Staking and Tying: Stake all trees of 2- through 5-inch caliper. Use three stakes, with of length that will penetrate at least 18 inches below bottom of backfilled excavation and to extend at least 72 inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses. All evergreens get 3 stakes.
 - 2. Use two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper.
 - 3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 - 4. Support trees with two strands of tie wire, encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.08 ORNAMENTAL GRASSES AND PERENNIAL PLANTINGS

- A. Set out and space ornamental grasses as indicated in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.09 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 48-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
 - 2. Organic Mulch in Ornamental Grasses Planting Area: Apply 3-inch average thickness of organic mulch extending over the entire island where the ornamental grasses are located, and finish level with the top of the surrounding curb. Do not place mulch within 3 inches of stems.
 - 3. Submit two samples for approval of shredded hardbark mulch and taconite screenings.

3.10 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- D. At the end of the 24 month maintenance period (24 month maintenance period begins at Substantial Completion of vegetation installation of project), remove all stakes and ties and re-mulch the beds and add to taconite screenings as needed.

3.11 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ornamental grasses areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.12 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.13 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION

SECTION 32 94 43 TREE GRATES**PART 1 - GENERAL****1.01 SCOPE OF WORK**

- A. The Conditions of the Contract and the provisions of Division 01 apply to all work of this Section.
- B. This Section includes all labor, materials, equipment and services necessary to furnish and install all landscape accessories as shown on the drawings and specified herein.
- C. Related Work Specified Elsewhere:
 - 1. Planting Preparation - Section 32 91 00
 - 2. Plants - Section 32 93 00

1.02 SYSTEM DESCRIPTION

- A. Provide cast iron tree grates.

1.03 SUBMITTALS

- A. Prepare and submit shop drawings to the Architect for approval in accordance with the requirements of Division 01. For manufacturer's stock items requiring no modification or special fabrication, manufacturer's literature will be acceptable in lieu of shop drawings.

PART 2 - PRODUCTS**2.01 MANUFACTURERS**

- A. Plans and specifications have been developed based on items manufactured by Neenah Foundry Company. Manufacturers that offer products which may comply with the requirements of this contract include, but are not limited to, the following:
 - 1. Neenah Foundry Company, 2121 Brooks Avenue, Neenah, WI 54956, (800) 558-5075.

2.02 MATERIALS

- A. Tree grates shall be cast iron grates formed in two pieces with a 15" expandable diameter tree opening in the middle. Tree grate shall be furnished with a cast iron angle frame. Tree grate shall be Neenah Foundry - R-8721 A 48" x 48" Parkway Collection Tree Grate.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Install tree grates in strict accordance with manufacturer's directions in locations shown on the drawings.

END OF SECTION

SECTION 33 46 13

FOUNDATION DRAINAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building perimeter weep drainage system.

1.2 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide data on pipe, and pipe accessories.

1.3 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Section 01 70 00.
- B. Record location of pipe runs, connections, cleanouts and principle invert elevations.

1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable code for installation of the work of this section.

1.5 FIELD MEASUREMENTS

- A. Verify that field measurements and elevations are as indicated.

1.6 COORDINATION

- A. Coordinate work under provisions of Section 01 30 00.

PART 2 PRODUCTS

2.1 MANUFACTURERS - PIPE MATERIALS

- A. Advanced Drainage Systems.
- B. Substitutions: Under provisions of Section 01 60 00.

2.2 PIPE MATERIALS

- A. Corrugated Plastic Tubing: 6 inch wrapped perforated tubing as manufactured by Advanced Drainage Systems.

- B. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

2.3 ACCESSORIES

- A. Pipe Coupling: Solid plastic.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with pea gravel fill as specified in Section 31 23 23 - Fill.
- B. Remove large stones or other hard matter which could damage drainage piping or impede consistent backfilling or compaction.

3.3 INSTALLATION

- A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.
- B. Place drainage tile on filter aggregate placed under Section 31 23 23 - Fill.
- C. Lay pipe to slope gradients noted on Drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Place pipe with perforations facing down. Mechanically join pipe ends.
- E. Install pipe couplings.
- F. Aggregate installed at sides, over joint covers and top of pipe under Section 31 23 23 - Fill.

3.4 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 01 40 00.
- B. Request inspection prior to placing aggregate cover over pipe.

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DULUTH, MINNESOTA**

**SECTION 33 46 13 – FOUNDATION
DRAINAGE SYSTEMS**

3.5 PROTECTION

- A. Protect finished installation under provisions of Section 01 50 00.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION

SECTION 34 71 13.26

VEHICLE GUIDE RAILS

PART 1 GENERAL

This Section specifies requirements for supplying and installing steel W-beam guide rail for garage wall protection.

1.1 RELATED SECTIONS

- A. Section 09 91 00 – Painting.

1.2 MEASUREMENT PROCEDURES

- A. Measure supply of steel W-beams and necessary hardware in linear feet of beam delivered to Project site. Length measured does not include laps.
- B. Measure supply of terminal sections of steel W-beam as individual units delivered to Project site.
- C. Measure supply of timber offset blocks for steel W-beam guide rail as individual units delivered to Project site.
- D. Measure supply of materials and construction of steel W-beam guide rail anchorages as individual units installed.

1.3 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
- B. AASHTO M180-2000, Corrugated Sheet Steel Beams for Highway Guardrails.
- C. American Society for Testing and Materials (ASTM International)

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Trinity Highway Products; 2525 Stemmons Freeway, Dallas, TX 75207, Phone: (800) 527-6050, Fax: (214) 589-8423.
- B. Other acceptable manufacturers offering equivalent products:
 - 1. Bushwick Metals, LLC
 - 2. Diversified Highway Products

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GUIDE RAILS**

3. Southern Guard Rail Co.
4. Road Systems, Inc.
5. Gregory Industries, Inc.

C. Substitutions: Under the provisions of Section 01 60 00.

2.2 COMPONENTS

- A. Steel W-beam guide rail as indicated and to following requirements:
 1. Steel rail and terminal sections: to AASHTO M180, class A Type 1 zinc coated.
 2. End section: W-beam bridge connector, 10-gauge.
 3. Bolts, nuts and washers: to ASTM A 307, hot dip galvanized to ASTM A 153/A 153M.
- B. Organic zinc-rich coating: to ASTM-A780 4.2.2.
- C. Sawn timber offset blocks:
 1. As per MnDOT 10-7.02.01 Standard Plate 8307 and Contract Drawings.

PART 3 EXECUTION

3.1 ERECTION

- A. Set blocking by instrument for alignment, and locations as indicated on Construction Documents.
- B. Construct anchorages to details as indicated.
- C. Erect steel W-beam components to details as indicated. Lap joints in direction of traffic. Tighten nuts to 74 lbs/ft. (100 N.m) torque. Maximum protrusion of bolt 1/2 in. (12 mm) beyond nut.

3.2 PAINTING (TOUCH UP)

- A. Galvanized steel-touch up:
 1. Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas in accordance with Section 09 91 00 – Painting. Pre-treat damaged surfaces according to manufacturer's instructions for zinc-rich paint.

A. END OF SECTION

END OF SECTION

